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# RADIOLOGY

A MONTHLY JOURNAL DEVOTED  
TO CLINICAL RADIOLOGY AND  
ALLIED SCIENCES



OCTOBER · 1961

VOLUME 77

NUMBER 4

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# RADIOLOGY

A MONTHLY PUBLICATION DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

PUBLISHED BY THE RADIOLOGICAL SOCIETY OF NORTH AMERICA, INC.

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## Value of Laryngography in Vocal Cord Tumors<sup>1</sup>

J. MEDINA, M.D., W. B. SEAMAN, M.D., P. CARBAJAL, M.D., and DANIEL C. BAKER, M.D.

ACCURATE KNOWLEDGE of the exact site and extent of laryngeal tumors is a vital prerequisite for proper therapeutic management. Although conventional clinical technics, including direct and indirect endoscopy, are reliable and accurate, their limitations in determining the extent of disease do not appear to have been appreciated. Areas where clinical methods may fail to reveal tumor invasion include the pre-epiglottic space, the subglottic region, the laryngeal ventricles, the thyroid cartilage, and the base of the epiglottis (6, 8, 10).

Since 1922, when Coutard (7) pointed out the usefulness of the lateral roentgenogram of the neck, this view has been an important adjunct in the evaluation of tumors of the larynx and pharynx. Invasion of the pre-epiglottic space and thyroid cartilage may be detected by this method and the contours of the vallecula, epiglottis, and upper aryepiglottic fold may be demonstrated. Recently, however, a review of a large series of lateral roentgenograms of the neck by Bate, Ruiz, and Bachman (5) showed almost 60 per cent to be unsatisfactory for proper evaluation of the larynx. The introduction of tomography in the frontal projection by Leborgne (10) greatly increased the usefulness of roentgenography in laryngeal disease, but even this refinement frequently fails to provide sufficient detailed information regarding the extent of

malignant involvement. Powers, McGee, and Seaman (14) described a roentgenographic method for examining the larynx, utilizing local anesthesia and coating the laryngeal mucosa with Dionosil Oily. This procedure provides a wealth of anatomic detail and a higher incidence of successful examinations than do the other two roentgen methods. Recently Ogura, Powers, *et al.* (13) reported their experience with the laryngographic technic in a study of 96 surgically proved cases of laryngeal cancer. The accuracy of this method of determining the precise extent of the disease was 92 per cent as compared to an accuracy of 78 per cent achieved in this same group of patients by conventional clinical methods. Since our experience with this procedure has also been favorable, we are presenting here a review of 100 laryngographic examinations performed at the Columbia-Presbyterian Medical Center.

### TECHNIC

Our laryngographic technic is essentially the same as that originally described by Powers, McGee, and Seaman. The most important feature is thorough anesthesia of the laryngopharynx and upper trachea. Xylocaine, in 2 to 4 per cent concentration, is used for a topical spray, and a few cubic centimeters are instilled directly into the trachea through a curved metal cannula. Approximately 5 to 15 c.c. of Dionosil Oily is injected into the larynx and

<sup>1</sup> From the Departments of Radiology (J. M.; W. B. S.) and Otolaryngology (P. C.; D. C. B.), Columbia University, College of Physicians and Surgeons, and Presbyterian Hospital, New York, N. Y. Accepted for publication in January 1961.



Fig. 1. Lateral laryngogram showing relationship of lower border of thyroid cartilage (in black) to inferior margin of vocal cord outlined by contrast medium.

hypopharynx, through a curved metal cannula, and multiple spot-films are obtained in the frontal and lateral positions during quiet respiration, phonation, the Valsalva and the modified Valsalva maneuvers. This last consists of blowing through the closed lips in order to distend the supraglottic larynx and hypopharynx with air. It is advisable to instruct the patient in these maneuvers prior to the installation of the contrast material so that the examination can be carried out as quickly as possible. Cineradiography has been used in a few instances and is an interesting research tool, but for routine clinical work only a spot-filming fluoroscope is necessary. A preliminary soft-tissue lateral roentgenogram of the neck is useful for detection of thyroid cartilage involvement and invasion of the pre-epiglottic space. Only 5 of 100 studies in this series were unsatisfactory for technical reasons.

#### ANATOMICAL AND PHYSIOLOGICAL CONSIDERATIONS

It must be emphasized that the interpretation of a radiograph of the larynx cannot be done with accuracy unless the physiologic status at the time of roentgenography is known. Therefore, although the detailed anatomy of the normal laryngogram has already been described



Fig. 2. Lateral projection demonstrating a large anterior subglottic tumor (B). Extension of tumor below inferior border of the calcified thyroid cartilage (A) establishes the anatomical site as subglottic.

(13), a few of the anatomic physiologic variations will be briefly discussed.

In the lateral view a thin line representing the contrast medium coating the laryngeal surface of the epiglottis continues through the region of the anterior commissure and into the upper trachea (Fig. 3). In some patients there may be a localized posterior displacement so that a small bulge is seen in the region of the anterior commissure. This is usually maximal during the modified Valsalva maneuver (Fig. 4) but is seen, to a lesser degree, during phonation. The contour of the bulge is usually smooth but in one instance exhibited slight irregularity (Fig. 5). This normal variant should not be mistaken for involvement of the anterior commissure or subglottic extension of a laryngeal cancer. The small anterior projection which interrupts the smooth continuity of the laryngeal surface of the epiglottis and subglottic area represents the appendix of the laryngeal ventricle and is a valuable landmark indicating the upper surface of the vocal bands.

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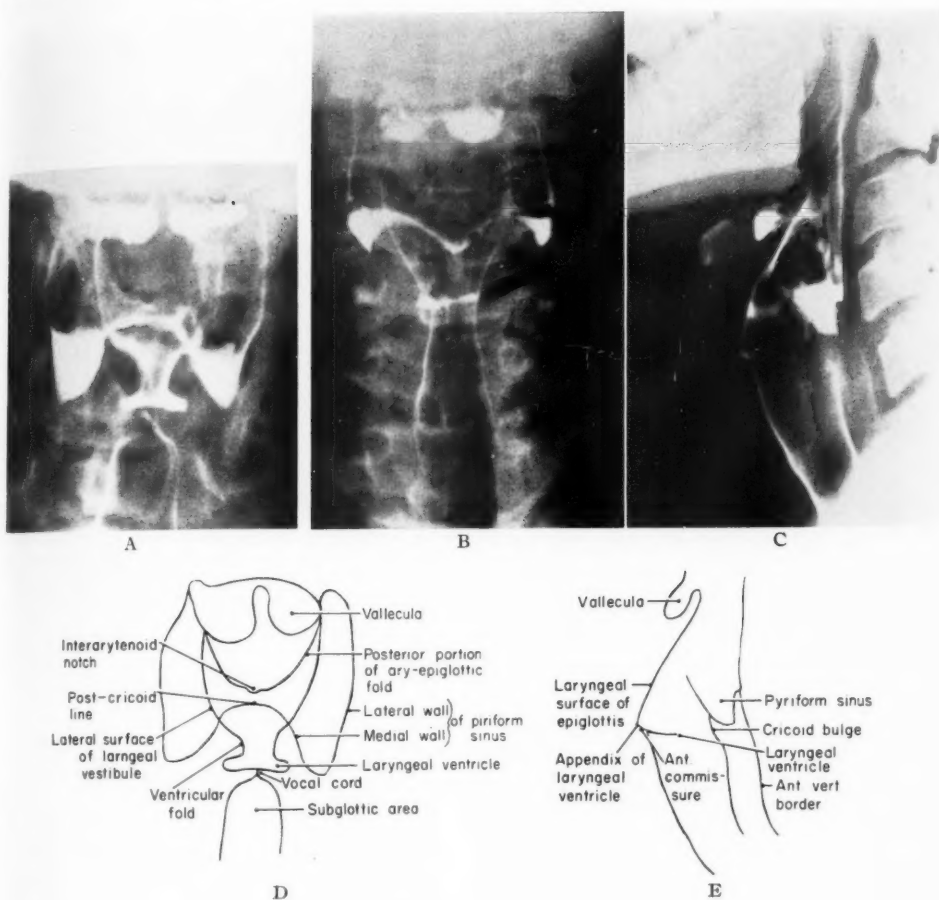


Fig. 3. Frontal laryngogram of a normal larynx during phonation. Vocal cords meet in midline. Note symmetry of true cord, ventricles, and false cords.

B. Frontal view of normal larynx during quiet respiration. Cords are not visualized, due to extreme abduction. Transverse line of contrast medium represents the laryngeal ventricle (arrow).

C. Lateral view of normal larynx. This film was taken during quiet breathing, when the cords are widely abducted. The ventricles are almost obliterated and are represented by only a thin streak of contrast material. Note that the contrast material anteriorly presents as a continuous line delineating the laryngeal surface of the epiglottis, anterior commissure, subglottic region, and trachea. The slight posterior bulge of the anterior commissure is a normal finding. The slight anterior indentation just above the anterior commissure represents the appendix of the laryngeal ventricle.

D. Line diagram of A demonstrating anatomical landmarks.

E. Line diagram of C demonstrating anatomical landmarks.

The lower border of the thyroid cartilage corresponds closely to the inferior border of the vocal cord when the patient is breathing quietly (Fig. 1). This landmark establishes the beginning of the subglottic region and is easily identified on lateral roentgenograms of the neck when the cartilage is calcified (Fig. 2). On the lateral laryngogram the inferior border of

the cord is frequently coated with contrast material, particularly during the Valsalva maneuver. Occasionally, during quiet respiration the inferior border of the cord may have a serrated appearance, but this is usually transient and disappears during phonation.

Posterior bulging of the laryngeal surface of the epiglottis is a normal physiologic



Fig. 4. Accentuation of posterior bulge of the anterior commissure during modified Valsalva maneuver. This is a normal variant and should not be mistaken for neoplastic invasion of the anterior commissure or subglottic area.

variant and, as beautifully demonstrated by Ardran *et al.* (1), indicates partial closure of the larynx. This phenomenon is particularly obvious during coughing, phonating, and the Valsalva maneuver (Fig. 7). An extreme example of this sphincteric type of laryngeal closure is occasionally seen in patients who are incompletely anesthetized (Fig. 6). The bulging may simulate pre-epiglottic space invasion, and the complete closure might suggest a supraglottic tumor. The transient character of these phenomena permits easy recognition of their true nature.

Certain variations in the frontal configuration of the subglottic region are encountered. Slight widening of the angle formed by the lateral subglottic wall and inferior margin of the vocal band may be seen during phonation and the Valsalva maneuver, but may also accompany a

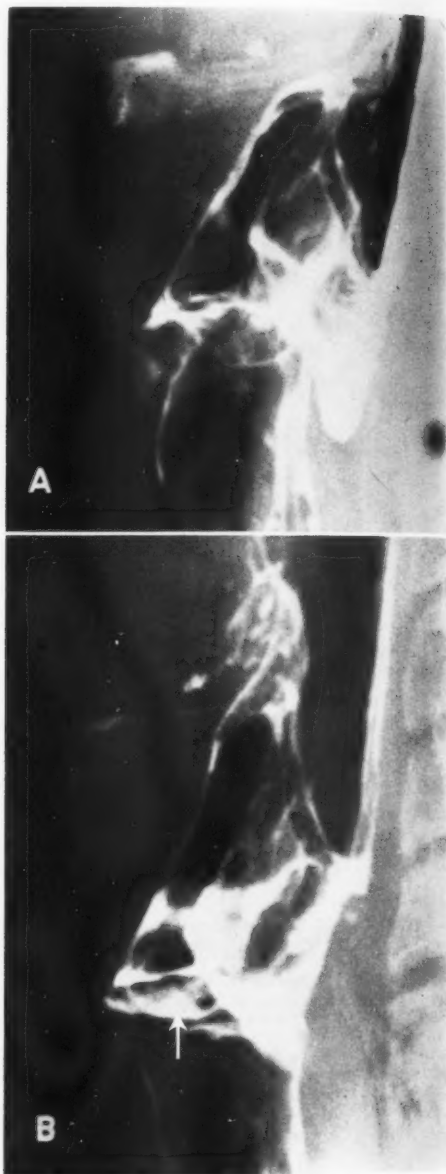


Fig. 5. A. Another example of accentuation of the posterior bulge of the anterior commissure occurring during the modified Valsalva maneuver. This normal variant is illustrated also in Fig. 4. The bulge usually has a smooth contour but in the present example it is slightly irregular.

B. Disappearance of bulge during quiet respiration. Arrow points to polypoid tumor arising on the posterior aspect of the true cord. There was no evidence of tumor in the anterior commissure or anterior portion of the true cords.

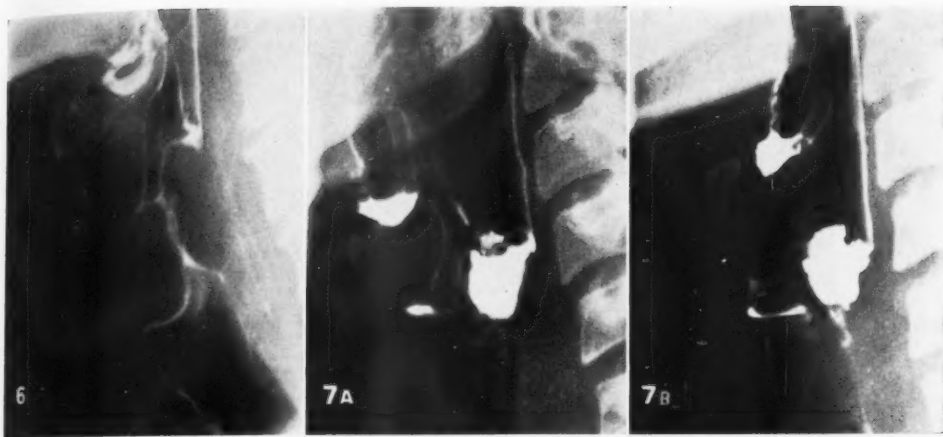


Fig. 6. Physiological response to incomplete anesthesia, characterized by marked spasm of glottis and supraglottic musculature.

Fig. 7. Posterior bulge of laryngeal surface of the epiglottis during phonation (A). This is a normal variant and disappears during quiet respiration (B).

contralateral cord paralysis. These appearances are usually transient and should not be mistaken for the submucosal type of subglottic extension.

#### BENIGN VOCAL CORD TUMORS

Benign polyps of the cords were studied in 8 patients prior to direct laryngoscopy and biopsy, and all were demonstrated by laryngography. In some cases there were widening of the ventricle and downward displacement, giving the impression on the lateral roentgenogram of ventricular dissociation as seen in cases of cord paralysis. Frequently a double contour on the inferior surface of the cord due to projection of the polyp beyond the cord (Fig. 8) was also observed. If the polyp is located anteriorly, a double contour may be present in the region of the anterior commissure in the lateral projection (Fig. 9).



Fig. 8. Benign polyp of the vocal cord projecting below the inferior border of the true cord, producing a double contour.

#### MALIGNANT VOCAL CORD TUMORS WITH SUBGLOTTIC EXTENSION

Nineteen patients with malignant neoplasms of the vocal cords were examined. One had vocal cord cancer with only anterior supraglottic extension (Fig. 15). Since an important reason for laryngography in malignant laryngeal tumors is the detection of subglottic extension (3,

6, 9, 11), this feature will be discussed in some detail.

Subglottic extension of a cordal cancer is universally recognized as indicative of a poor prognosis, since even small localized lesions in this area respond poorly to radiotherapy and recur rapidly (4). If surgery is contemplated, the degree of subglottic

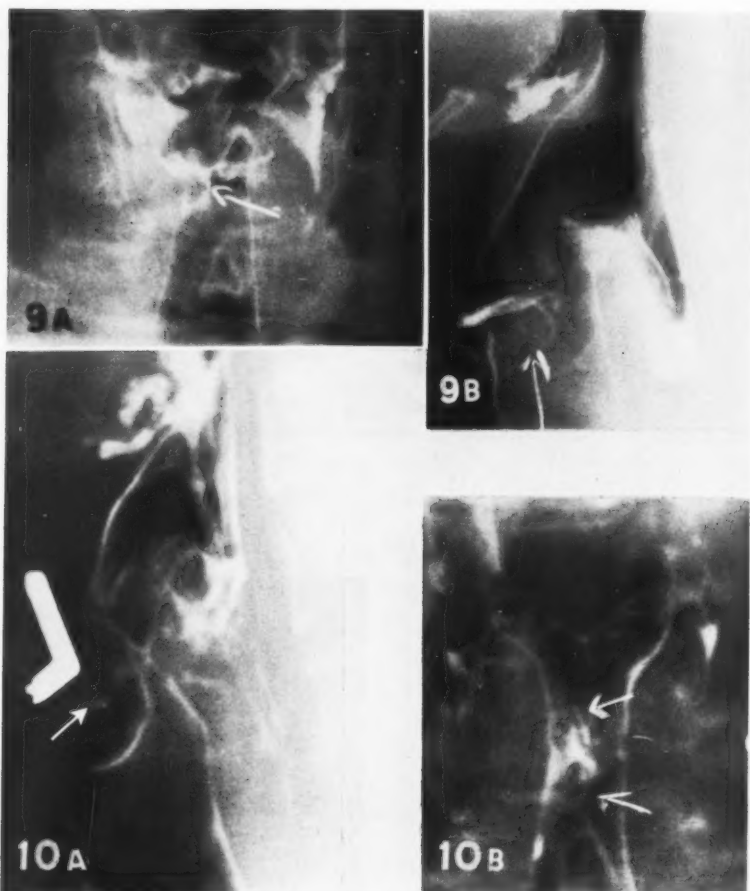


Fig. 9. A. Frontal view of benign polyp of the vocal cord projecting above into the laryngeal ventricle and below into the subglottic region. Film was obtained during quiet respiration and cords are not visible because of maximal abduction.

B. Lateral view of same patient during modified Valsalva maneuver. Polyp presents anteriorly as an annular shadow due to coating of its surface by contrast material.

Fig. 10. A. Lateral laryngogram of patient with a large polypoid carcinoma of the cord with subglottic and supraglottic extension. Arrow points to contrast material outlining anterior portion of the laryngeal ventricle.

B. Frontal laryngogram during quiet breathing. Large mass on the right indicated by arrows.

extension may determine the number of tracheal rings to be resected.

The subglottis extends from the level of the vocal cords to the lower edge of the cricoid cartilage, where it becomes continuous with the trachea. The lower border of the cricoid cartilage marks the boundary between subglottis and trachea and is easily recognized when the cartilage is calcified. In the absence of calcification, the subglottis can usually be identified

during the Valsalva maneuver by the greater dilatation of the trachea.

Our experience with 9 patients with subglottic involvement (Table I), confirmed by surgical and pathological findings, substantiates the limitation of endoscopy in this area. Definite evidence of subglottic extension was obtained in only 1 patient by direct laryngoscopy, but was demonstrated by laryngography in 8 and was strongly suspected in the remaining 1.

TABLE I: SUMMARY OF PATIENTS WITH CORDAL CANCER AND SUBGLOTTIC EXTENSION

Patient	Endoscopy (Direct and Indirect)	Laryngography	Treatment	Pathology
I. H. A.	Ulcerated, left cord thickened	Fixed left cord, obliteration of left ventricle. Definite left subglottic extension in both lateral and frontal views. Enlarged right cord with encroachment in right laryngeal ventricle	Total laryngectomy and left radical neck dissection	Epidermoid carcinoma involving entire left true and false cord, ventricle, and anterior 2/3 of right cord. Subglottic extension 1.8 cm. on left. Lymph nodes negative
II. L. K.	Large tumor involving both cords, bilateral arytenoid areas. Left cord fixed, right slightly movable. Part of the cords obscured by tumor mass. Subglottic area not seen	Extensive tumor obliterating configuration of true and false cords bilaterally and the ventricle, with marked narrowing of airway. Marked subglottic extension, also supraglottic invasion to involve laryngeal vestibule	Total laryngectomy and left radical neck dissection	Large (4 × 3.5 cm.) mass on left involving vestibule, left false and true cords and ventricle and extending across to the right cord. Subglottic extension to 0.5 cm. above first tracheal ring. Well differentiated epidermoid carcinoma. Lymph nodes negative
III. J. B.	Ulcerating papillary lesion extending entire length of left cord. Both cords mobile	Irregular thickening of left cord with encroachment of left ventricle. Partial fixation of left cord with definite left subglottic extension	Total laryngectomy and left radical neck dissection	Ulcerated carcinoma involving entire left cord with extension into left ventricle and left subglottic region. Lymph nodes negative
IV. G. A.	Irregular lesion of entire length of right true cord. Cords mobile	Mass lesion of right cord with definite subglottic and supraglottic extension. Cords mobile	Partial laryngectomy	1.8 × 1.7-cm. lesion of right cord with extension into ventricle and 1.2 cm. subglottically. Well differentiated epidermoid carcinoma
V. F. D.	Lesion middle third of right cord. Cords mobile	Partial fixation of right cord with definite evidence of right subglottic extension	Right hemilaryngectomy	Thickening and induration of right true cord with right subglottic extension. Epidermoid carcinoma
VI. C. R.	Small lesion of posterior left cord. Cords mobile. Subglottic region not well visualized	Large tumor of subglottic region, and upper trachea involving right anterolateral and posterior walls. Cords mobile	Total laryngectomy, and left radical neck dissection	Large mass on right and posterior walls of trachea and subglottic region. Mucosal extension of epidermoid carcinoma around entire circumference of trachea. Extension to inferior surface of left true cord. Right true cord not involved. Lymph nodes negative
VII. J. B.	Ulcerated lesion of right cord with extension to anterior commissure and vocal process of arytenoid. Cords mobile	Irregular lesion of right cord with suggestive right subglottic extension. Cords mobile	Total laryngectomy	Epidermoid carcinoma involving entire right true cord, anterior commissure and extension into right subglottic region. Lymph nodes negative
VIII. T. J.	Granular lesion of anterior half of right cord involving anterior commissure. Subglottic extension suspected but not visualized	Irregular right true cord with right subglottic mass and involvement of anterior commissure	Radiotherapy followed by recurrence. Subsequent total laryngectomy and right radical neck dissection	Tumor of right true cord with right subglottic extension for a distance of 2.0 cm. Lymph node metastases
IX. B. S.	Lesion of midportion of left true cord with subglottic extension	Tumor of left cord with subglottic extension	Radiotherapy followed by local recurrence. Subsequent total laryngectomy and left radical neck dissection	Epidermoid carcinoma of left true and false cords, extension to anterior commissure, anterior right cord and left subglottic region



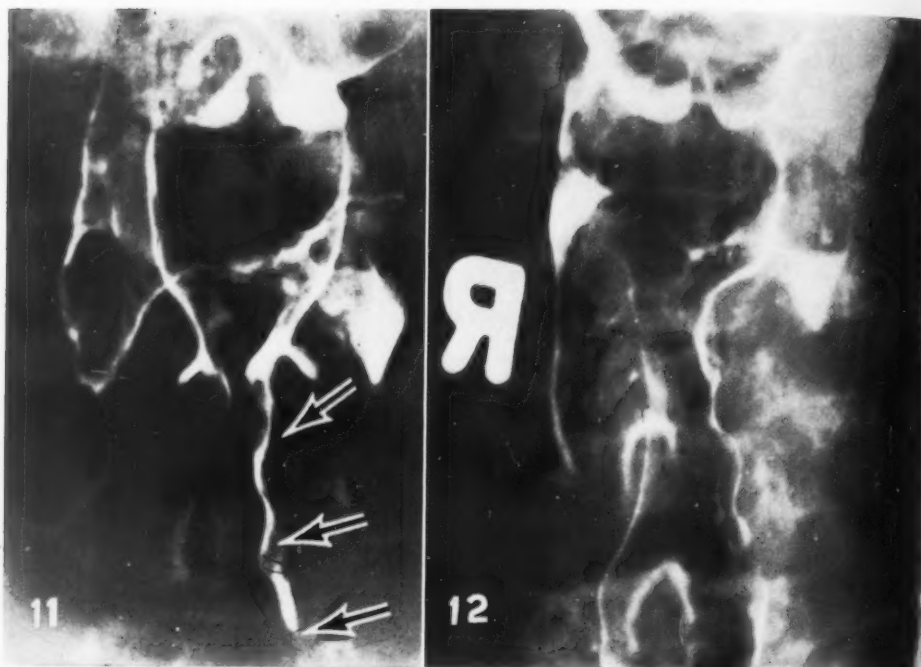


Fig. 11. Infiltrative type of subglottic extension of a carcinoma arising from the inferior portion of the left true cord.

Fig. 12. Infiltrative type of subglottic extension on the left with fixation of true cord and obliteration of laryngeal ventricle. Disappearance of ventricle and cord on the right is a physiological phenomenon due to extreme abduction. Inward displacement of subglottic mucosa on the right is a frequent normal variant. Examination of surgical specimen revealed tumor extending 1.8 cm. below the glottis.



Subglottic extension has been classified by Baclesse (3) as lateral, anterior, and posterior. Posterior extension is quite rare, while the lateral type is the most frequent. The roentgen appearance in lateral extension may range from a slight blunting of the normally acute subglottic angle to massive encroachment (Fig. 14). When the subglottic extension is limited to the anterior wall, demonstration by either conventional roentgen technics or tomography may be impossible, and the laryngographic method is most valuable.

Subglottic extension can also be classified radiographically according to its pathologic features, as polypoid, infiltrative, and submucosal. We have found that the

Fig. 13. Submucosal subglottic extension from a carcinoma of the right vocal cord. This type of subglottic extension can be differentiated from the normal variant shown on the right side in Figure 12 by its constancy.



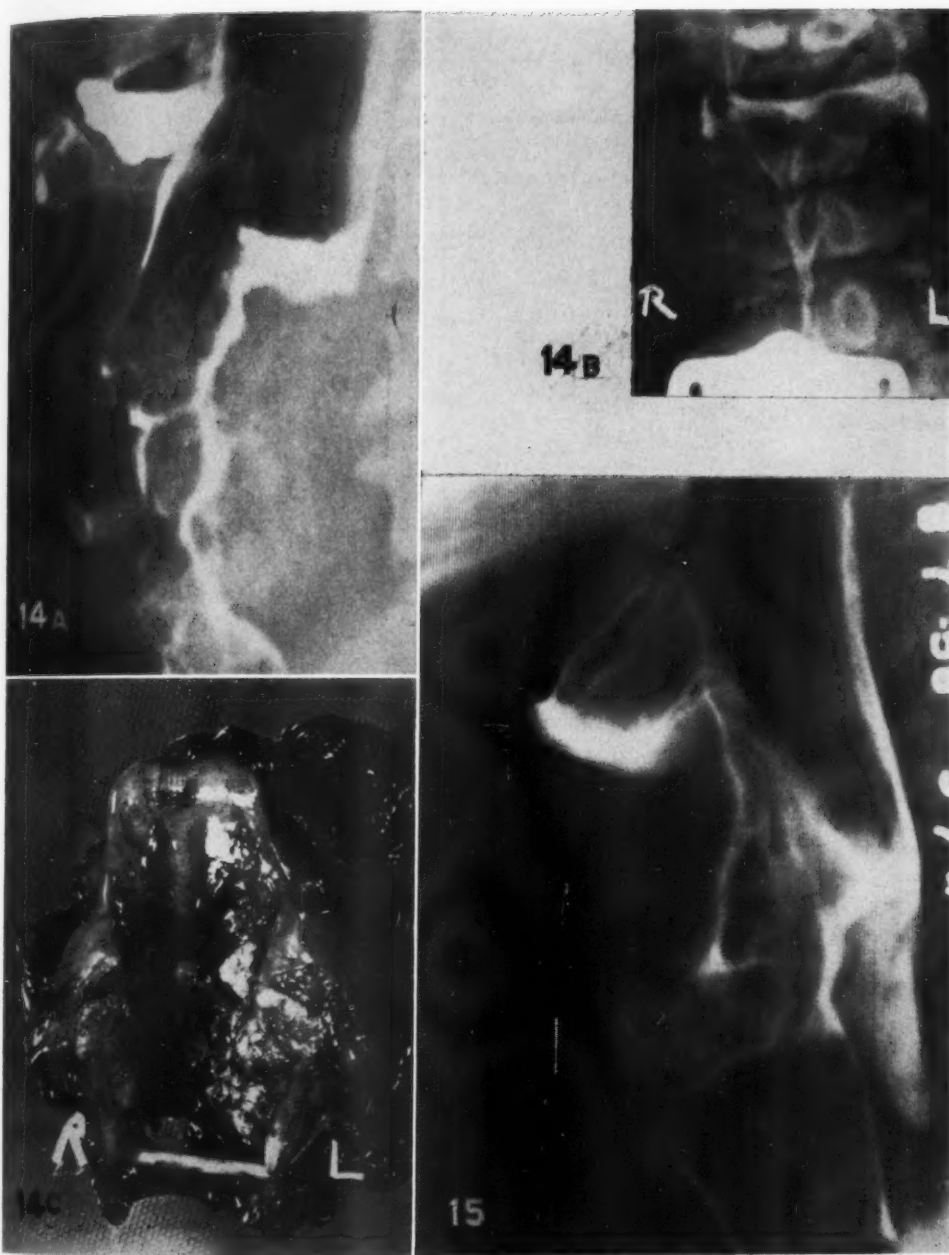


Fig. 14. A. Lateral view of a patient with marked supra- and subglottic extension from a carcinoma of the left cord. Note widening of the space between the inner surface of the thyroid cartilage and the laryngeal mucosa due to tumor infiltration.

B. Frontal laryngogram.

C. Photograph of the excised larynx showing the extent of the tumor.

Fig. 15. Discontinuity of mucosal coating of laryngeal surface of the epiglottis due to supraglottic extension of a vocal cord cancer.

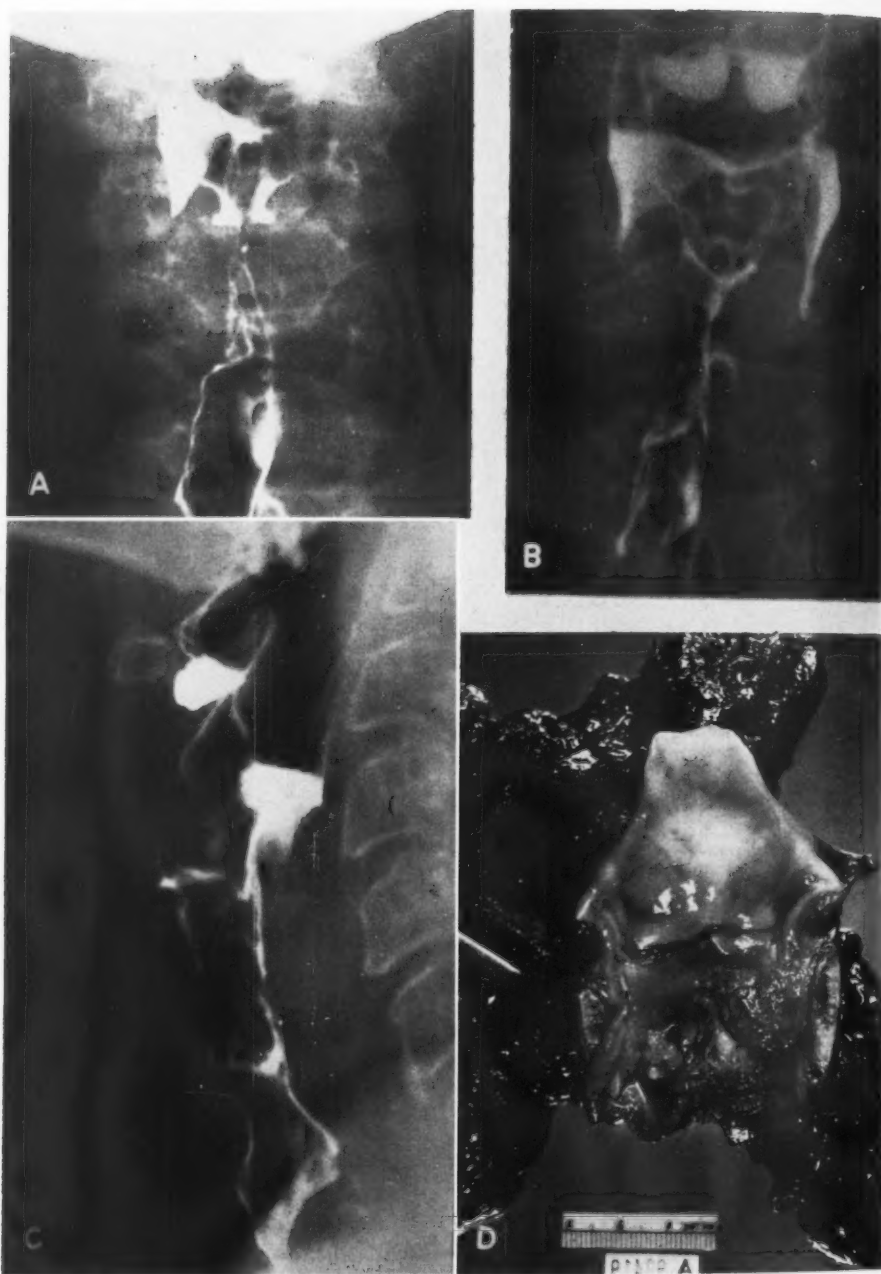


Fig. 16. A. Frontal laryngogram during phonation, of a patient with an extensive primary subglottic tumor involving chiefly the right and posterior wall of the trachea and subglottic region.  
 B. Maximal abduction of the vocal cords during quiet breathing indicates no impairment of mobility.  
 C. Lateral view showing smooth outline of anterior commissural and immediate anterior subglottic region.  
 D. Photograph of surgical specimen.

contour of the subglottic area is significantly related to the growth pattern of the primary tumor. Figure 10 illustrates the polypoid nature of both the primary tumor and its subglottic extension. The infiltrative neoplasm produces obliteration or widening of the subglottic angle and irregularity of the lateral wall (Figs. 11 and 12). The submucosal type is similar except that the lateral wall has a smooth contour and may be more difficult to distinguish from anatomical variants or extrinsic pressure from a large thyroid (Fig. 13).

The differential diagnosis of subglottic extension includes the normal variants previously mentioned. Usually their transient character serves to indicate their true nature. Primary subglottic tumors may occur, although they are rare. Baclesse reported only 13 primary subglottic tumors in a series of 341 cases of laryngeal cancer (4). Lederman (12) feels that many reported glottic lesions are actually of subglottic origin, having extended superiorly to involve the vocal cords. This series includes 1 example of a primary subglottic tumor with minimal involvement of one cord. The cords exhibited normal mobility and the true extent and site of the neoplasm were not appreciated except from the laryngogram (Fig. 16).

The trachea and subglottic area may also be involved by malignant tumors arising elsewhere in the neck, as was demonstrated in 1 patient in this series with carcinoma of the thyroid, or the subglottic area may be deformed by extrinsic pressure from benign enlargement of the thyroid. Alterations in subglottic configuration may also be produced by cord paralysis. Submucous edema may be indistinguishable from true neoplastic infiltration and constitutes an unavoidable source of error. At times the mobility of the cords and flexibility of the subglottic configuration may be helpful distinguishing features.

#### CONCLUSIONS

A roentgen method of examining the larynx, utilizing local anesthesia and a

mucosal coating of Dionosil Oily, is described, which provides a wealth of anatomic detail and a higher incidence of successful examinations than the conventional lateral roentgenogram or tomography in the frontal projection.

Experience with 100 laryngographic studies by this method has been reviewed with special consideration of tumors of the vocal cords. Some of the normal physiological and anatomic variations as they occur on laryngograms, with particular emphasis on the subglottic region, have been discussed. Eight patients with benign polyps and 19 with malignant neoplasms of the vocal cords were examined.

The laryngographic technic is reliable and valuable in determining the precise extent of laryngeal neoplasms and is particularly important in the demonstration of subglottic extension. Direct laryngoscopy afforded definite evidence of subglottic extension in only 1 of 9 patients with proved neoplastic disease in that area. Laryngography definitely demonstrated subglottic involvement in 8 cases and strongly suggested it in the remaining case.

Acknowledgment is made to Dr. P. Morales, San Juan, P. R., and Dr. George Shipman of Marine Hospital U.S.P.H.S., Staten Island, for permission to use Figures 2 and 15, respectively.

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## SUMMARIO IN INTERLINGUA

## Le Valor del Laryngographia in Tumores del Cordas Vocal

Le examine roentgenographic del larynge, utilisante anesthesia local e un revestimento de Dionosil Oily (Dionosil Oleose), provide abundante informationes de detalio anatomic e un plus alte incidentia de successose examines que le methodo conventional de roentgenographia lateral e que studios tomographic in un projection frontal.

Es presentate un revista del experientia in 100 studios laryngographic executate per medio de iste methodo, con attention special prestate a tumores del cordas vocal. Esseva examinate octo patientes con polypos benigne e 19 con neoplasma maligne del cordas vocal.

Le technica laryngographic es fidel e de alte valor in le determination del precise extension de neoplasmas laryngee. Illo es

particularmente importante in le demonstration de extensiones subglottic. Laryngoscopia directe provideva definite evidencia de extension subglottic in solmente un inter novem patientes con un provate affection neoplastic de iste area. Laryngographia, del altere latere, demonstrava definitemente le presentia de affection subglottic in octo casos e suggereva lo forteamente in le ultime caso.

In casos de extension subglottic lateral, le apparentia roentgenologic pote variar inter un leve obtusification del normalmente acute angulo subglottic e un ingression massive. Le contorno del area subglottic es relationate significativamente con le configuration crescential del tumor primari—que pote esser polypoide, infiltrative, o submucosal.



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# Serial Radiography to Assist Irradiation of Carcinoma of the Nasopharynx

ALEXANDER W. PEARLMAN, M.D.

**F**EW TUMORS with so characteristic a clinical course are diagnosed as late as nasopharyngeal carcinoma, which often goes unrecognized until cervical metastases are present. Yet there are few regions in the head and neck which lend themselves better to radiographic examination. The nasopharynx is an air-filled cavity with boundaries that can be readily delineated on the roentgenogram. A systematic study with emphasis on serial films is a valuable tool in the management of patients undergoing irradiation for nasopharyngeal tumors. Such an examination delineates the soft-tissue mass, is simple to perform, causes little or no patient discomfort, and may be repeated at frequent intervals, as required.

The importance of roentgenography, with or without opacification of the nasopharynx, was recognized many years ago by Zupping (6). A sizable literature, mainly European, has accumulated (1). Baclesse, in his book *Tumeurs malignes du pharynx et du larynx* (1), devotes an entire chapter to the x-ray examination of the nasopharynx and to the demonstration of representative tumors. Reference should be made to this treatise for a detailed analysis of the normal and abnormal roentgenogram.

Radiography limited to a pretreatment study is not without value, demonstrating the size and location of the tumor. It is, however, by analysis of serial radiographic studies, with the pretreatment film as a point of reference, that it has been possible to evaluate regression during irradiation and thus to classify tumors according to their site of origin. We have performed serial studies routinely during irradiation of most cases of carcinoma of the nasopharynx. Ideally, a com-

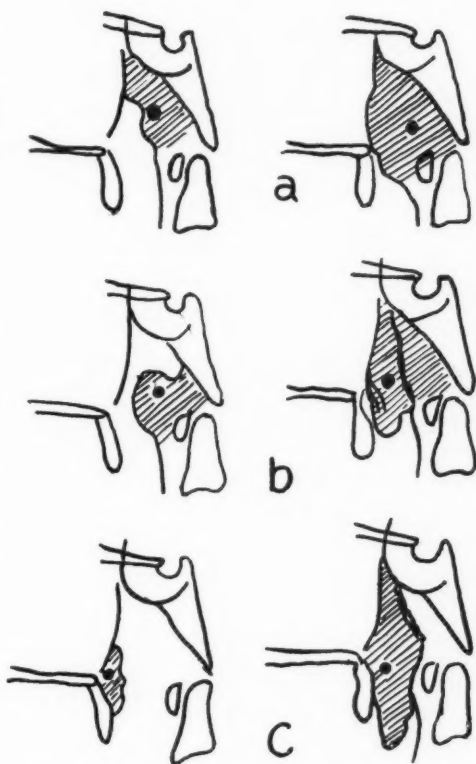


Fig. 1. Classification of nasopharyngeal tumors according to the site of origin of the tumor. After Baclesse (1), reproduced by permission.

The dot indicates the origin of the tumor as determined by repeated examinations during the period of regression. Relatively small tumors are illustrated on the left and voluminous tumors on the right.

a. Tumors arising from the posterosuperior wall and roof.

b. Tumors of the fossa of Rosenmüller.

c. Tumors arising from the nasopharyngeal aspect of the palate.

Compare diagrams with the radiographs in Figures 2-8.

prehensive pretreatment study is performed. This includes (a) a lateral radiograph of the nasopharynx, soft-tissue technic (a 6-foot tube-target focal distance with horizontal x-ray beam mini-

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Fig. 2. H. Y., a 67-year-old Chinese male, gave a history of pain in the left ear and gradual loss of hearing over a period of one year. A nodular tumor covered the posterior lip of the torus and fossa of Rosenmüller, with spread to the posterolateral wall. *Histology*: undifferentiated squamous-cell carcinoma, Grade 3.

a. Pretreatment lateral soft-tissue roentgenogram. A round, sharply demarcated tumor projects from the lower part of the posterior wall of the nasopharynx. The location of the mass, just superior to the odontoid, is characteristic for tumors of the fossa of Rosenmüller. The roof of the nasopharynx is normally aerated.

b. Line drawing of a.

c. Contrast nasopharyngogram, prior to treatment. The filling defect obliterates the fossa of Rosenmüller. The roof is normally filled. The magnification is due to the short focal distance.

d. Contrast nasopharyngogram, following a tumor dose of 6,000 r in thirty-five days. At clinical examination, there was no evidence of tumor. The mucosal reactions were still severe. The nasopharyngogram is normal.

mizes distortion), (b) lateral skull tomograms, and (c) contrast nasopharyngograms (lateral and axial views). One or more of these studies were repeated during treatment, at the conclusion of treatment, and as part of the follow-up examination.

Lateral soft-tissue roentgenography, which is the simplest of the procedures to perform, may suffice to demonstrate the soft-tissue tumor (3-5). The addition of lateral midline tomograms eliminates confusing extraneous shadows. The mass is silhouetted against the air-filled nasopharyngeal cavity. It has been possible to follow the progress of tumor regression with tomograms alone (Fig. 4), but the examination cannot be considered complete without contrast nasopharyngography. Examination in the lateral and axial projections delineates the tumor in its three dimensions, permitting precise localization and accurate estimate of size and extent. In addition, the integrity of the base of the skull can be evaluated from the axial view. By contrast, stereo mentovertex views, without prior opacification of the nasopharynx, yield information limited to the osseous structures, since the soft-tissue mass can rarely be visualized in this projection.

Contrast nasopharyngography is a relatively simple procedure which requires no special equipment. The nasal passages are anesthetized locally, and the patient is placed on the x-ray table in the supine position. Both shoulders are elevated to permit maximum extension of the neck. The contrast material, either Lipiodol or Dionosil Oily, is instilled into each nostril simultaneously, and the patient is instructed not to swallow. Approximately 10 to 15 c.c. of the medium is required. It may be introduced by a dropper into the anterior nares or by a catheter placed in the posterior nasal cavity. Either method is satisfactory. A lateral exposure is made with a horizontal x-ray beam at relatively long tube-film distance, to avoid distortion. Without disturbing the patient, a mentovertex projection is made with the Potter-Bucky diaphragm, to visualize the lateral walls of the nasopharynx and the base of the skull. Multiple filming with fractionated doses of opaque material has been suggested to improve diagnostic accuracy. It is thought that small tumors might be hidden when the nasopharynx is completely opacified with a large blob of medium (2). We have no experience with this fractionated procedure.



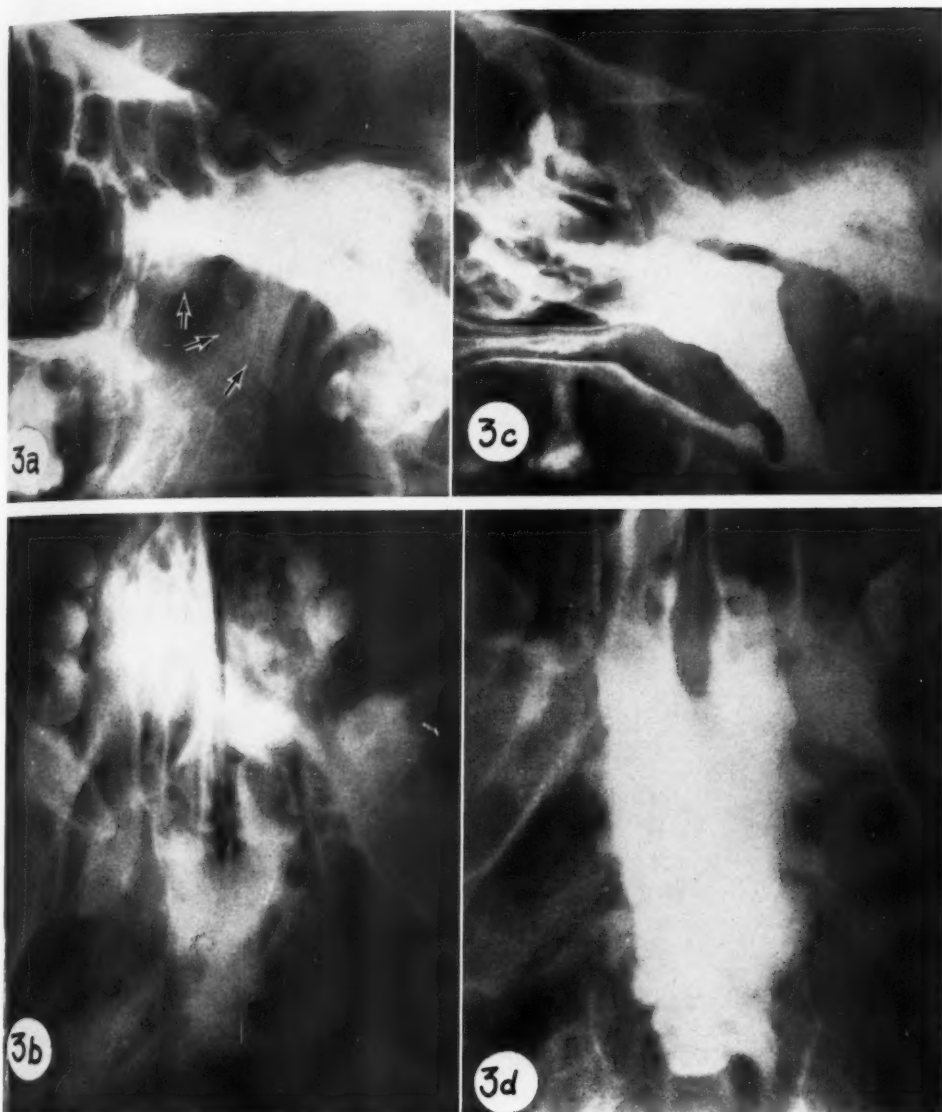


Fig. 3. B. J., Negro female 34 years old, had symptoms for eight months: double vision, inability to focus on objects, and severe generalized headaches. On examination, a large mass was seen to fill the upper nasopharyngeal cavity, involving both lateral walls and the roof. *Histology*: squamous-cell carcinoma.

a. Pretreatment lateral soft-tissue roentgenogram demonstrates the tumor, which extends from the roof to the level of the odontoid process. The air column is narrowed.

b. Pretreatment axial view. The filling defect on both lateral walls is demonstrated, as well as osteolytic metastasis in the base of the skull.

c and d. Axial and lateral contrast nasopharyngograms following a tumor dose of 6,000 r in five weeks. There is no radiographic evidence of residual tumor. Clinical examination confirmed this finding.

The normal nasopharyngogram is illustrated in Figures 2-5. The nasal cavities and the fossa of Rosenmüller are opacified and the roof, posterior wall, and naso-

pharyngeal surface of the palate are coated with the medium. The shadow of the fossa of Rosenmüller merges with the main column of contrast material. It is

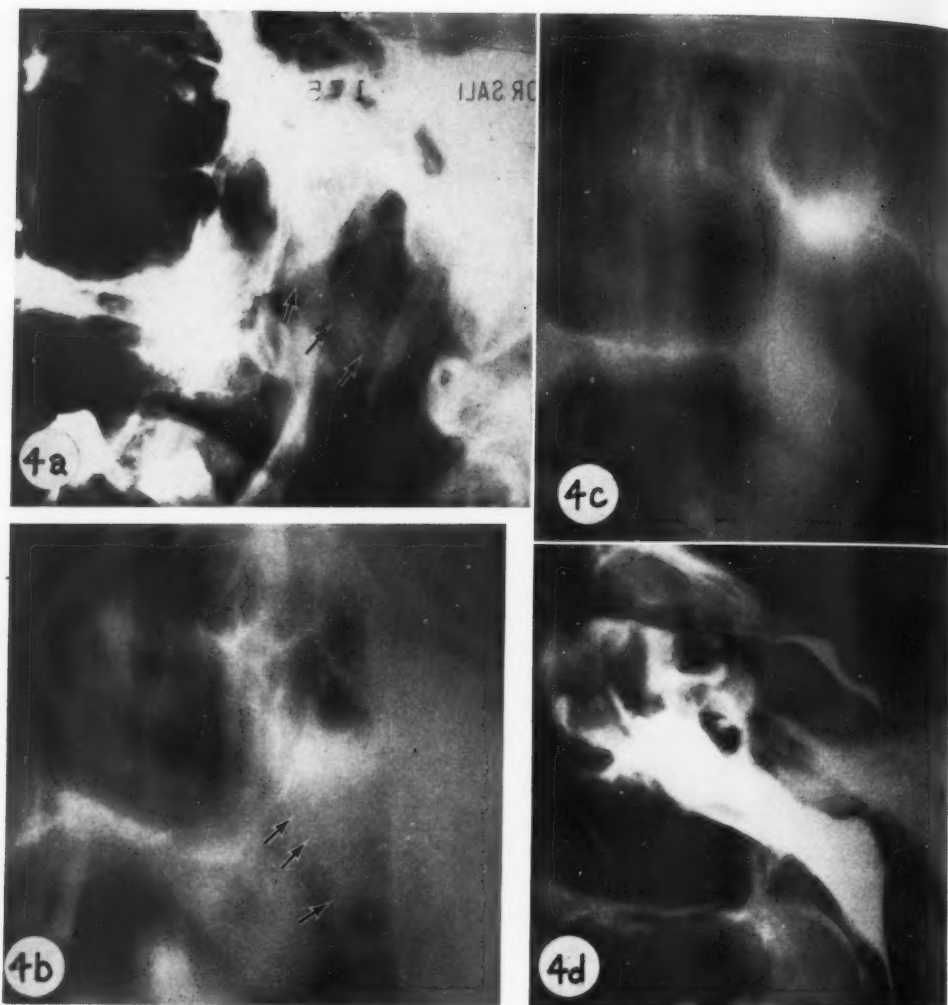


Fig. 4. E. L., 44-year-old white male, had a large friable mass extending to the roof of the nasopharynx. *Histology*: squamous-cell carcinoma, undifferentiated.

a. Pretreatment lateral soft-tissue roentgenogram. A soft-tissue mass extends from the roof to the posterior wall of the nasopharynx. Only a narrow airway remains.

b. Pretreatment lateral tomogram demonstrating the soft-tissue density to better advantage by eliminating overlying structures.

c. Lateral tomogram after a tumor dose of 2,700 r in nineteen days (250 kv.; Thoraeus filter; h.v.l. 2 mm. Cu; two opposing lateral 6 X 6-cm. portals). The residual tumor occupies the roof of the nasopharynx, indicating its site of origin. Clinical examination was restricted by a severe radiation reaction.

d. Contrast nasopharyngogram, one year later. There is no evidence of tumor. Patient has remained well for three and one-half years.

triangular in shape, with its base cephalad, and lies adjacent to the postero-inferior wall of the nasopharynx.

Combined clinical and radiographic studies have made possible a classification of nasopharyngeal tumors based upon the anatomic site of origin of the neoplasm.

The three subgroups are illustrated in Figure 1, which is taken from Baclesse. As may be seen from the diagram and in the subsequent radiographs, differentiation is dependent upon accurate localization of the tumor on pretreatment films and serial observations of its shrinkage. Vo-



Fig. 5. T. S. Y., a 55-year-old Chinese male, had a mass protruding from the roof of the mouth, present for approximately two years, gradually increasing in size. It measured 5 cm. in diameter and was spherical. The palate bulged forward. The nasopharynx was filled with tumor tissue and the cavity could not be seen. *Histology*: Poorly cornifying squamous-cell carcinoma, Grade 3.

a. Pretreatment contrast nasopharyngogram. Despite repeated attempts to instill the medium, none entered the nasopharynx. Incomplete filling of the posterior nasal cavity indicates forward extension of the tumor. The possibility of origin in the nasal cavity with secondary invasion of the nasopharynx must be considered. The bulk of the tumor, however, is within the nasopharynx.

b. Pretreatment lateral tomogram demonstrating the nasopharyngeal component of the tumor, which is continuous with the soft palate and extends upward along the anterior wall of the nasopharynx (choanae). The remainder of the nasopharynx is well aerated despite the clinical impression of tumor filling the entire cavity.

c. Contrast nasopharyngogram after Dn 3,000 r (cobalt beam, two opposing  $6 \times 8$ -cm. lateral portals). As compared with a, the contrast medium enters the nasopharynx and the filling defects in the posterior nasal cavity are no longer present. Residual tumor is indicated by the pressure defect on the contrast column adjacent to the soft palate. Seventy-five per cent tumor shrinkage with half of the projected dose is an indication of the radiosensitivity of this particular tumor. The residual tumor also indicates its origin from the palate.

d. Contrast lateral nasopharyngogram after completion of full course of treatment (Dn 6,000 r). No evidence of residual tumor.



Fig. 6. P. M., 42-year-old white male. Excision of a small mass from the back of the throat two years before the present admission had been followed by early recurrence and a gradual increase to a huge size. On examination, the palate and uvula were pushed forward by a spherical mass, measuring 4.5 cm. in diameter and apparently originating from the nasopharyngeal cavity. *Histology:* squamous-cell carcinoma.

a. Pretreatment lateral soft-tissue roentgenogram showing obliteration of the airway. A large soft-tissue density bulges the soft palate forward and extends inferiorly to the level of the odontoid.

b. Contrast nasopharyngogram after Dn 4,000 r in thirty days (cobalt beam, two opposing lateral 8 × 10-cm. portals). Tumor shrinkage was clinically esti-

luminous tumors are difficult, if not impossible, to classify when first seen, but during treatment the shrinking mass focuses on the site of origin. This classification has practical clinical value and helps to define a heterogeneous group of tumors.

The most commonly occurring tumors arise from the fossa of Rosenmüller and adjacent torus (Figs. 2 and 3). On the initial examination, they generally are sufficiently large to be visualized on the lateral film as localized soft-tissue tumefactions projecting from the postero-inferior wall of the nasopharynx. The filling defect, as seen in the lateral contrast nasopharyngogram, indents and obliterates the shadow of the fossa of Rosenmüller. Larger tumors spread upward toward the roof and fill the nasopharyngeal cavity. Axial views demonstrate the extent of the tumor defect along the lateral wall. Metastasis in the base of the skull may also be visualized in this projection. These tumors are in close approximation

to the residual mass indents the contrast column opposite the nasopharyngeal surface of the soft palate, and origin from this site is now obvious. Radiosensitivity of the tumor is indicated by the relatively rapid tumor shrinkage.

c. Contrast lateral nasopharyngogram at completion of therapy (Dn, 6,000 r in fifty days). Tumor shrinkage was clinically estimated at 90 per cent. There is residual thickening of the soft palate. Subsequently there was complete tumor regression.

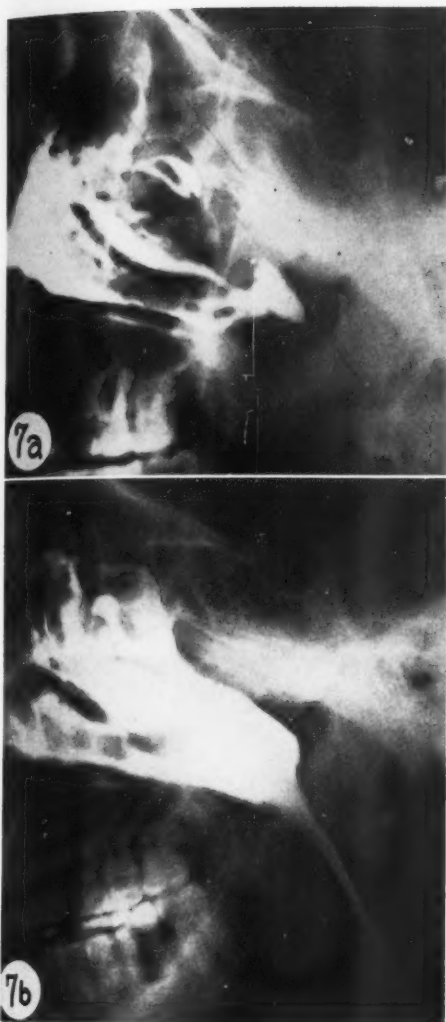


Fig. 7. C. Y., a 65-year-old Chinese male, complained chiefly of severe headaches. A large mass filled the nasopharyngeal cavity. *Histology:* Infiltrating basal-cell carcinoma.

*a.* Contrast nasopharyngogram before treatment. Despite repeated attempts to fill the nasopharynx, only a small amount of contrast medium outlines the roof. A soft-tissue mass fills the remainder of the nasopharynx.

*b.* Contrast nasopharyngogram after Dn 3,000 r in three weeks. There is a napkin-ring deformity with smooth canalization of the nasopharyngeal cavity. The tumor extends inferiorly to the pharynx and cannot be classified as to site of origin. Its appearance is unique; no other example with a similar aspect was encountered. This is the only basal-cell carcinoma of the nasopharynx seen in this clinic.

*c.* Axial view obtained at the same time as *b*. There was no evidence of bony destruction in the base of the skull.

to the base of the skull and spread in all directions. Lateral extension into the wall of the nasopharynx is often associated with intermittent hemorrhages and lymphatic dissemination (1, 3).

Next in incidence are tumors of the roof and posterosuperior wall. The tumor projects into the superior aspect of the nasopharynx and is contiguous with the floor of the sphenoid sinus (Fig. 4). Indentation of the superior margin of the contrast column is characteristic. A tumefaction may be seen in this region in children with hypertrophied adenoidal

tissue. The clinical course of carcinoma arising in the roof resembles that of neoplasms of the fossa of Rosenmüller, and the pattern of spread is similar.

Tumors of the roof must be distinguished from tumors arising in the posterior ethmoid cells or from the sphenoid sinus when the latter have secondarily invaded the nasopharynx. This can best be ac-





Fig. 8. A Chinese lady, 69-years-old, complained chiefly of generalized headaches and intermittent nasal bleeding for two years. Examination revealed a friable mass covering the area of the left torus and fossa of Rosenmüller. *Histology:* Differentiated epidermoid carcinoma. Irradiation was given through two cross-firing portals, cobalt beam, to a Dn 6,320 r in thirty-two days measured at the midplane of the nasopharynx. (Legend continued on opposite page)

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complicated by anatomic orientation of the main bulk of the tumor. The bulk of a nasopharyngeal tumor will lie behind a line drawn in the lateral roentgenogram, from the posterior margin of the hard palate through the middle of the floor of the sella turcica. Spheno-ethmoid tumors will lie chiefly anterior to this line (1). Here, too, the pattern of tumor shrinkage will aid in localizing the site of origin, as the earliest shrinkage occurs in the peripheral portions of the tumor which extend beyond the nasopharynx.

A small group of nasopharyngeal tumors arise from the nasopharyngeal surface of the palate. Our few patients had large bulky tumors which pushed the soft palate forward. Despite the large size of the tumors, there was rapid response to irradiation. Lateral roentgenograms demonstrated a mass continuous with the palate and separated from the roof and posterior wall by an air space of varying width. The tumors spread anterosuperiorly along the anterior wall of the nasopharynx. In large tumors the pretreatment contrast nasopharyngogram may show complete blockage of the choanae and varying degrees of invasion into the posterior nasal fossa (Fig. 5, a). Differentiation from tumors of the nasal cavity is relatively easy. Serial studies show early shrinkage in the nasal component of the tumor with re-establishment of the normal nasal passage (Fig. 5). Progressive regression can be more easily determined by coating the nasopharyngeal and oral surface of the palate with contrast material. The composite shadow of tumor and soft palate is sandwiched between the coated oro- and nasopharyngeal surfaces (Figs. 5 and 6).

An occasional tumor of the nasopharynx

defies classification despite serial studies. In Figure 7, a pretreatment nasopharyngogram shows tumor filling almost the entire cavity. A subsequent study, after approximately half the tumor dose was given, showed a smooth napkin-ring deformity in the lower nasopharynx. This is indicative of a circumferential growth without the usual localization.

The value of radiographic studies as part of the routine follow-up examination is demonstrated in Figure 8. Repeated nasal hemorrhages suggested a recurrence two years after the original course of treatment. Examination was difficult in an uncooperative, elderly patient with trismus. The x-ray studies demonstrated a lesion on the lateral wall of the nasopharynx, seen only in the axial view. Using this as a guide, the precise placement of a radium tandem within the nasopharynx was simplified.

#### SUMMARY

A radiographic technic for examination of the nasopharynx in patients undergoing irradiation for nasopharyngeal neoplasms has been presented. It entails serial radiographic examinations, usually with contrast medium, during and after therapy.

The classification of nasopharyngeal tumors, based on their site of origin, follows that of Baclesse: most common are tumors of the fossa of Rosenmüller, then tumors of the roof and posterosuperior wall, and finally tumors of the nasopharyngeal surface of the palate. The allocation of tumors in individual patients has been materially aided by serial roentgen studies.

A serial record of tumor regression has lead to individualization of the tumor dose. This is most important when tumor

Fig. 8. (see opposite page) a. Pretreatment lateral soft-tissue roentgenogram. The characteristic soft-tissue tumefaction is seen on the postero-inferior wall of the nasopharynx.

b. Lateral contrast nasopharyngogram. The patient was well for two years when she again experienced bleeding from the nose and posterior throat. Examination was extremely difficult, but a friable tumor could be seen on the lateral wall. The extent of the tumor was not evident by examination alone. The lateral view shows no abnormality.

c. Axial contrast nasopharyngogram obtained at the same time as b. The filling defect along the lateral wall of the nasopharynx is now clearly demonstrated. The tumor extends to the posterior nares. Note the shadow of the nasal septum.

d. Axial view with radium tandem *in situ*. Comparison with c has made it possible to plan an accurate placement of the radium capsules. An axial view one month after treatment showed no residual tumor.

regression is unusually slow and an upward revision of the dose is in order.

ACKNOWLEDGMENT: We are indebted to Dr. Michael E. Michaelides, resident physician in the Department of Radiation Therapy, whose technical assistance was invaluable.

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#### SUMMARIO IN INTERLINGUA

#### Radiographia Serial Como Methodo de Controlo in le Therapia Irradiator de Carcinoma del Nasopharynge

Le uso systematic de examines radiographic serial, normalmente con le substantia de contrasto instillate in le narinas, es de grande valor in le plano therapeutic total de patientes sub tractamento irradiatori pro tumores nasopharyngee. Le analyse del studios serial, con le pellicula de ante le tractamento como base de referencia, rende possibile evaluar le regression del tumor durante le irradiation e classificar assi le tumor secundo su sito de origine. Le plus commun es tumores del fossa de Rosenmüller. Illos es sequite in frequentia per tumores del fornice e del pariete posterosuperior. Le minus frequente es tumores del superficie nasopharyngee del palato.

Le allocation de tumores in le patientes individual ha devenite grandemente plus simple per le uso de studios roentgenographic serial. In tumores del fossa de Rosenmüller e in illos del fornice e del pariete posterosuperior, le contraction tende a comenciar periphericamente. Tumores del superficie nasopharyngee del palato manifesta le regression le plus precoce in le componente nasal, con le restablimento de normalitate del passage nasal.

Le registration serial del regression del tumor ha permittite le individualisation del dosage. Isto es importantissime quando le regression del tumor es inusualmente lente de maniera que un revision in alto del dosage usate pare indicate.



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# Cardiac Laminagraphy<sup>1</sup>

KENNETH D. McGINNIS, M.D.,<sup>2</sup> WILLIAM R. EYLER, M.D., and HERNAN ALVAREZ, JR., M.D.

LAMINAGRAPHY of the heart has proved to be a practical, simple, and highly useful radiographic technic of continuing value in daily practice. Its usefulness is apparent from the following considerations:

1. The identification of cardiac calcification is aided and the impression afforded

and can readily be shown to referring physicians in large or small groups without resorting to specialized projection equipment.

5. The procedure involves a relatively low radiation dose. The surface dose for a lateral view is 250 to 600 mr and the male gonadal dose 0.15 to 0.3 mr per film.

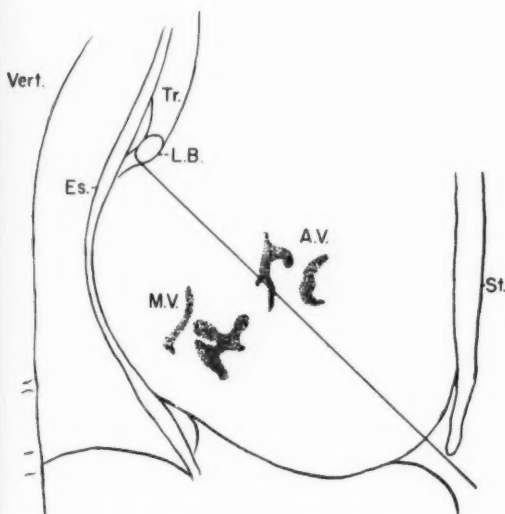


Fig. 1. Mitral and aortic valvular calcification (lateral laminagraph).

J. K., a 65-year-old white male, was seen with chest pain and hemoptysis. Murmurs of mitral stenosis, mitral insufficiency, and aortic stenosis were heard. An infarct of the right lower lobe was shown on the chest film. The patient died, but no autopsy was obtained. There are thought to be faint anterior calcifications in the left anterior descending branch of the left coronary artery. Marked calcification in both mitral and aortic valves is shown.

The bronchophrenic line separates the mitral valve (M.V.) and aortic valve (A.V.). L.B. Left bronchus. Tr. Trachea. Es. Esophagus. St. Sternum. Vert. Spine.

by fluoroscopy may be confirmed when the fluoroscopic density is minimal.

2. The ability to discriminate between the valves and between valves and other structures is improved.

3. The identification of multiple calcifications is greatly facilitated.

4. A permanent record of the amount of calcification and its location is provided

## ETIOLOGY

The etiological implications of valvular calcification have been the subject of many detailed anatomical studies since Mönckeborg (7) first considered this to be a degenerative process. Karsner and Koletsky (5) believed that aortic valvular calcification is a result of an inflammatory process that is usually, if not always, rheumatic.

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The series of cases upon which the present paper is based, as well as others, indicates that valvular calcification can be caused by various conditions damaging the valves (1, 8, 9), including arteriosclerosis, healed bacterial endocarditis, congenital valvular lesions, rheumatic heart disease, and brucellosis.

#### ROENTGEN DEMONSTRATION

Sosman's classic article (13) describes in detail the technic of fluoroscopic detection and localization of cardiac calcification.

tion groups for study of coronary calcifications.

Initially, laminagrams of patients in the present study were obtained in the anteroposterior, left lateral, and right posterior oblique projections. The left lateral decubitus was selected as the projection of choice for several reasons. The right posterior oblique allows the maximal separation of the aortic and mitral valve areas, but this is a difficult position to duplicate, and prediction of the proper plane for

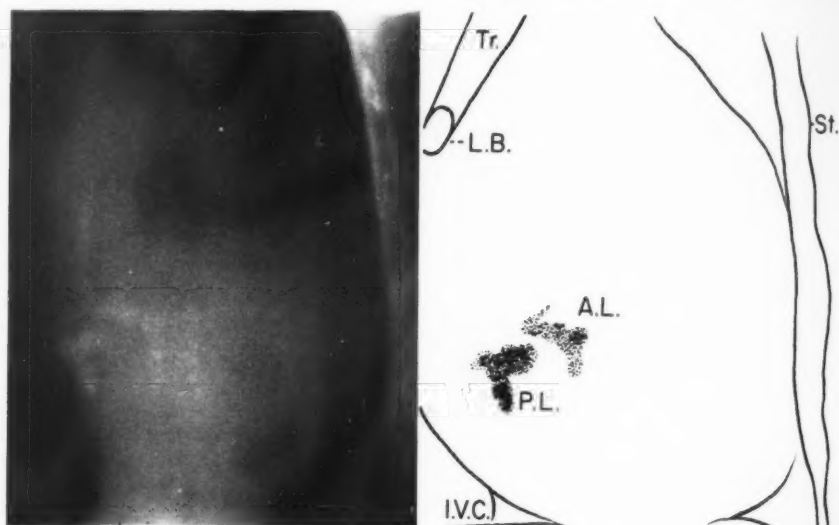


Fig. 2. Mitral valve calcification (lateral laminagram).

F. P., a 47-year-old white woman, was seen with marked weakness and shortness of breath of two years duration and murmurs of mitral stenosis. The blood pressure was 156/86. The mitral leaflets were densely calcified, small, and retracted at operation. The patient has done well but is now thought to have some re-stenosis. This film demonstrates the anterior leaflet (A.L.) and the posterior leaflet (P.L.). L.B. Left bronchus. Tr. Trachea. I.V.C. Inferior vena cava. St. Sternum.

Although finer focus tubes and more rapid exposures have made possible the demonstration of a greater number of calcifications on plain films, this remains the least dependable method of examination. Image intensification may improve the fluoroscopic image, while cinerentgenography adds documentation for physiologic study, but this approach is not generally used for routine cardiac fluoroscopy. Cardiac laminagraphy has been described by Soloff, Zatuchni, and Fisher (11, 12). The work of Jorgens *et al.* (4) indicates that cineradiography may be useful in certain popula-

laminagraphic sections was found to be much more difficult than in the other projections, so that more films were required. The valve positions in the left lateral decubitus projection have been found to maintain a relatively constant relationship to the sagittal plane in most cases. For particularly large hearts additional sections are indicated, but a standardized procedure may be used in most patients. Four laminagraphic sections at 1.0 cm. separation, beginning at the sagittal plane and extending to the left, are made when the valve area is to be evaluated. This must

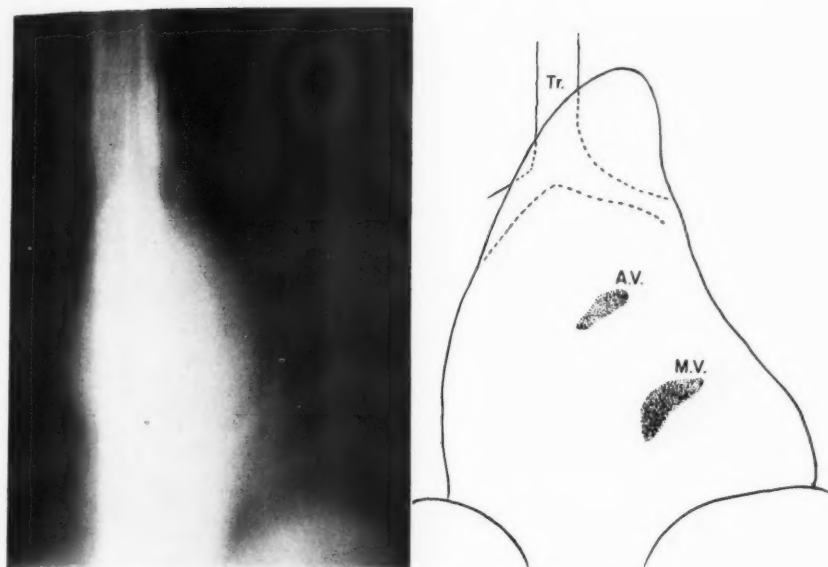


Fig. 3. Mitral and aortic valve calcification (antero-posterior laminagram).

J. H., a white male, forty-five years old, entered the hospital because of several episodes of paroxysmal nocturnal dyspnea. There was a history of rheumatic fever prior to the age of twelve. Murmurs of mitral stenosis and insufficiency and of aortic stenosis and insufficiency were heard. The blood pressure was 130/70. The patient had conventional mitral commissurotomy, with confirmation of valvular calcification, and a transventricular aortic valvulotomy at the same procedure. He was seen six and a half years later, and was doing well.

This case is shown to illustrate mitral and aortic valve calcification in the anteroposterior projection. M.V. Mitral valve. A.V. Aortic valve. Tr. Trachea.

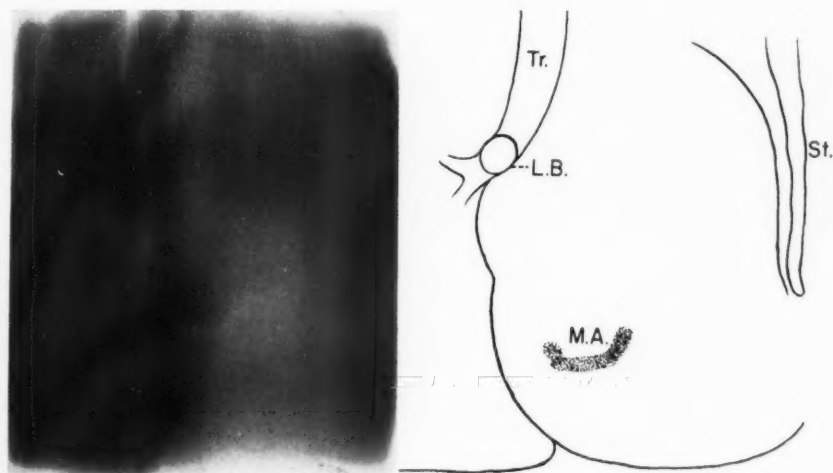
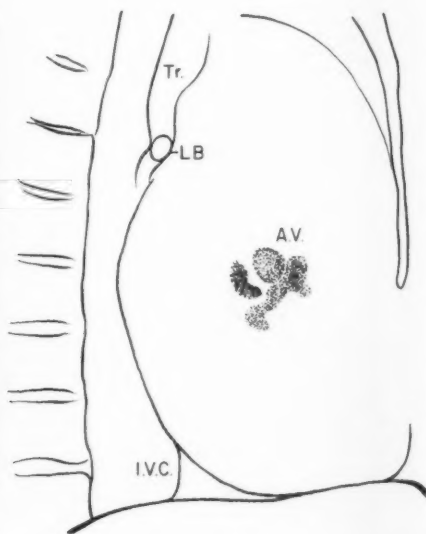
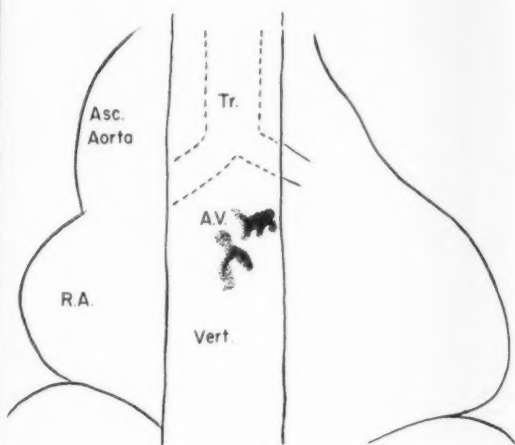


Fig. 4. Mitral annulus calcification (lateral laminagram).

T. M., a 71-year-old white male, had been followed for diabetes for some time. After a respiratory infection he had a routine chest examination, including postero-anterior and lateral views. Calcification was suspected and confirmed by laminagrams. Because of this, the patient was seen by a cardiac consultant. No history of rheumatic fever was obtained. A precordial systolic murmur was heard, which may be associated with some mitral insufficiency.

This case is shown as an example of cardiac calcification demonstrated in an asymptomatic patient. M.A. Mitral annulus. L.B. Left bronchus. Tr. Trachea. St. Sternum.



Figs. 5 and 6. Aortic valve calcification (anteroposterior and lateral laminagrams).

R. T., a white man, aged 40, complained of shortness of breath for six months. His past history included "growing pains" and inability to keep up with other children. Murmurs of aortic stenosis and insufficiency were heard. The patient succumbed with congestive failure and pulmonary edema. At autopsy massive calcification and fibrosis of the aortic valve were found, and there was a minimal calcification in the anterior leaflet of the mitral valve continuous with the aortic valve process. The appearance of the aortic valve in the anteroposterior (Fig. 5) and lateral (Fig. 6) projections is shown.

A.V. Aortic valve. R.A. Right auricle. L.B. Left bronchus. Tr. Trachea. I.V.C. Inferior vena cava. Vert. Spine.

be modified for thoracic and mediastinal deformities, as well as for any unusual configuration of the heart. Positioning may be checked by fluoroscopy, particularly if the calcification is not valvular.

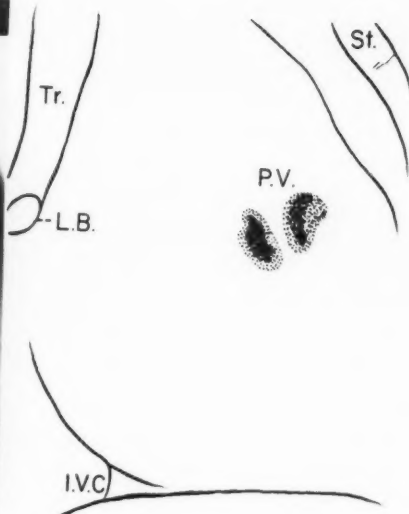
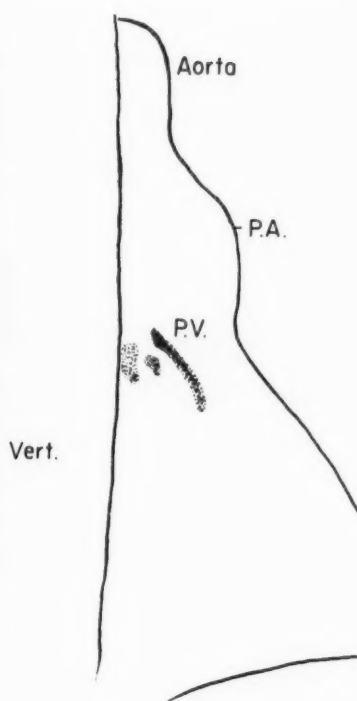
A multiple-layer cassette was tried but was found unsatisfactory due to lessened

resolution. A single-section technic is now used exclusively.

#### ROENTGEN ANATOMY

It has been helpful to divide the lateral cardiac laminagraphic silhouette by a diagonal line extending between two points





Figs. 7 and 8. Pulmonic valve calcification (anteroposterior and lateral laminagrams).

F. G., a 49-year-old white male, complained of exertional dyspnea. After an attack of scarlet fever at the age of sixteen, a harsh systolic pulmonic murmur was heard for the first time. The pulmonic second sound was absent. Plain film and fluoroscopic studies were classical for pulmonic valvular stenosis, and the diagnosis was confirmed by angiocardiology. P.V. Pulmonary valve. P.A. Pulmonary artery. Vert. Spine. Tr. Trachea. L.B. Left bronchus. I.V.C. Inferior vena cava. St. Sternum.

rather than into the previously described anterior, middle, and posterior thirds. The inferior point is the intersection of a line tangent to the anterior cardiac surface with a line tangent to the inferior cardiac surface. The posterior point is the inferior surface of the left main bronchus at the plane of the section. At this level the

compelling clinical and radiologic information.

#### OBSERVATIONS IN PRESENT SERIES

*Mitral Valve:* The mitral valve lies posterior, inferior, and to the left of the aortic valve and the center of the cardiac shadow. It is often possible to demonstrate separa-

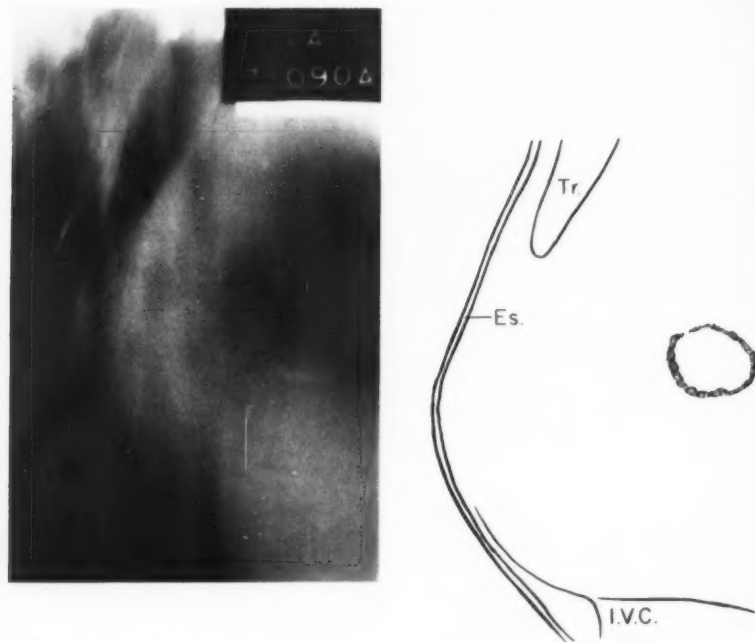


Fig. 9. Supra-aortic calcific ring (lateral laminagram).

G. B., a 51-year-old white man, had experienced attacks of rheumatic fever at the ages of fourteen and twenty. Angina had recently developed, and a murmur of aortic stenosis was audible. The blood pressure was 130/70. Mitral murmurs were also heard, indicating mitral insufficiency. At autopsy, the aortic valve was found to be stenotic and insufficient and the mitral valve incompetent, due to fibrosis and shortening of the chordae and thickening of the leaflets. The remarkable finding was a row of calcific excrescences in the base of the aorta, immediately above the sinuses of Valsalva, presumably built up as the result of the disturbed hemodynamics associated with the valvular stenosis. The case is presented to illustrate the differential diagnosis from aortic valvular calcification. Note the smooth ring character of this calcification.

bronchus is nearly horizontal and is easily identified. Figure 1, from a case of mitral and aortic valvular calcification, demonstrates the dividing line. This division is not infallible, but the line lay anterior and superior to the mitral valve and posterior and inferior to the aortic valve calcifications in 93 of 102 cases with calcification initially analyzed. This bronchophrenic line serves only as an aid in localization and is not used to the exclusion of other

tion of the posterior and anterior leaflets (Figs. 2 and 3). Calcification is more frequent in the valvular leaflets than in the commissural junction and is rare in the chordae, except for microscopic deposits (10). Calcification was found in 39 mitral valves in the present series. It was found in 22 of 61 cases of mitral stenosis, 5 of 23 cases of mitral insufficiency, 3 of 15 cases of combined mitral stenosis and insufficiency, and in 9 cases of combined mitral and aortic

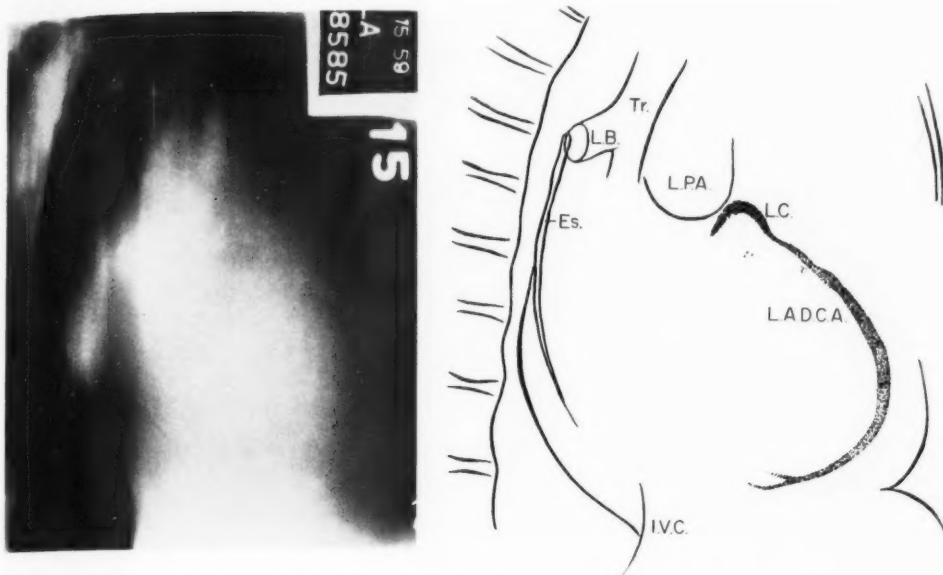


Fig. 10. Coronary artery calcification (lateral laminagram).

A. K., a 60-year-old white man, entered the hospital because of sudden onset of precordial pain radiating to the left arm. The blood pressure was 110/80. The electrocardiogram showed an acute posterior myocardial infarct with evidence of an old septal infarct. The patient survived the first episode, but he returned two months later and succumbed. Autopsy and radiography of the removed heart demonstrated extensive calcification in the coronary arteries. The laminagrams are shown to illustrate calcification in the left coronary artery and the anterior descending branch. Tr. Trachea. Es. Esophagus. L.P.A. Left pulmonary artery. L.C. Left coronary artery. L.A.D.C.A. Left anterior descending coronary artery.

valve disease. Although the incidence is somewhat greater in mitral stenosis, it is not sufficiently so to be of clinical significance.

In 3 cases mitral calcification was confined to the annulus. Anatomically (3) and radiographically, the mitral annulus is an incomplete ring appearing as a U-shaped density in the mitral area (Figs. 4 and 13).

**Aortic Valve:** The aortic valve lies anterior and superior to the mitral area in the lateral view and nearer the midline of the anteroposterior projection (Figs. 3, 5, and 6). Calcification was found in 66 aortic valves: in 47 of 49 patients with aortic stenosis, in 2 patients without recorded clinical evidence of valve disease, in 1 of 7 patients with aortic insufficiency, in 4 of 8 patients with insufficiency and stenosis, and in 12 of 30 patients with combined aortic and mitral involvement. Few patients were found with aortic valve calcification without a component of stenosis.

**Pulmonary Valve:** One case of calcifica-

tion in the area of the pulmonary valve was observed, in a patient meeting all the clinical and radiographic criteria for pulmonary valvular stenosis (Figs. 7 and 8). An angiocardiogram showed pulmonary valvular stenosis.

**Tricuspid Valve:** No calcification of the tricuspid valve was identified in our series.

**Calcification in Both Aortic and Mitral Valves:** Six cases of calcification in both aortic and mitral valves were found and they are included in these separate categories (Figs. 1 and 3).

**Pericardium:** Laminagrams were made in 3 cases of pericardial calcification. Examples obtained before and after subtotal pericardiectomy for constrictive pericarditis in 1 case are reproduced in Figure 14.

**Coronary Arteries:** Though the technic used was devised to show the valve areas to greatest advantage, coronary arterial calcifications were incidentally found in 3 patients. Extensive coronary calcifications were present in 1 case (Fig. 10). In the

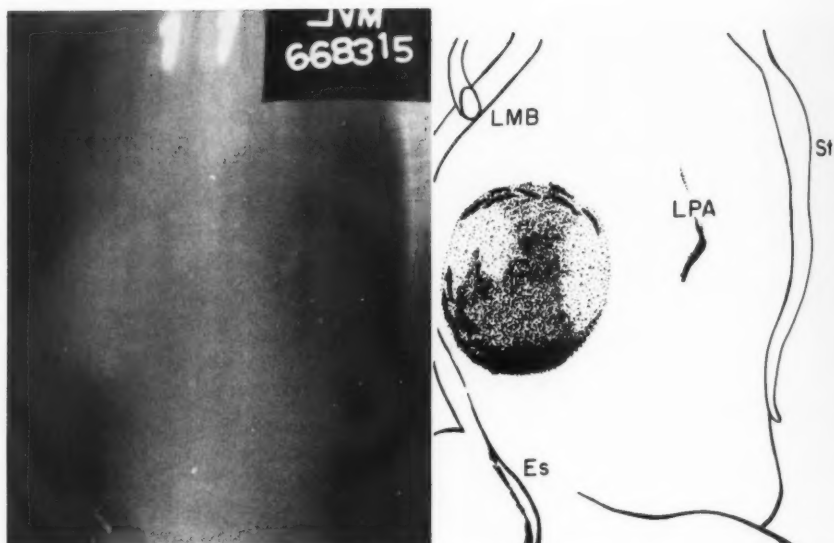


Fig. 11. Calcification of left atrial wall, left atrial thrombus, and left pulmonary artery thrombus (lateral laminagram).

N. C., a white woman, forty-five years old, complained of weakness and dyspnea. She had had "inflammatory rheumatism" in childhood. Murmurs of mitral stenosis were heard. The blood pressure was 120/85; right ventricular pressure was 125/12. Mitral commissurotomy was performed, but the patient succumbed from the procedure. At autopsy, extensive calcifications in the left atrial wall, left atrial thrombus, left pulmonary artery, and left pulmonary artery thrombus were found. L.M.B. Left main bronchus. St. Sternum. L.P.A. Left pulmonary artery and thrombus calcification. L.A. Left atrial wall and thrombus calcification. Esophagus.

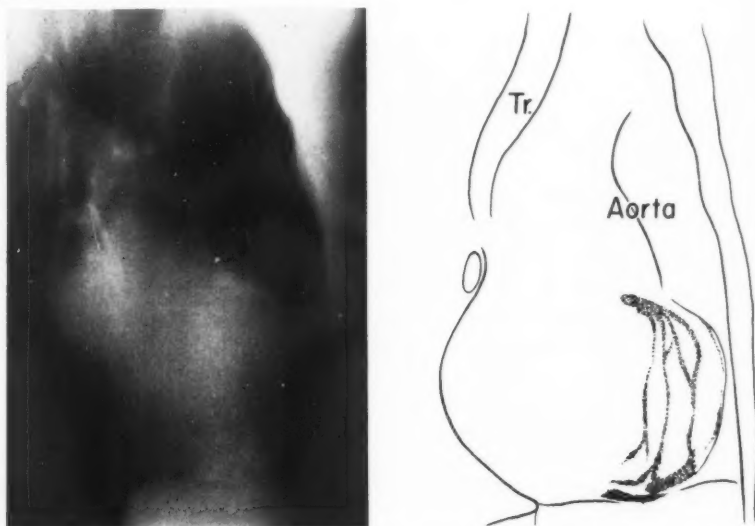


Fig. 12. Ventricular aneurysm calcification (lateral laminagram).

J. L., a 68-year-old white male, had sustained a myocardial infarct fifteen years previously. The electrocardiogram demonstrated the old anterolateral infarct with evidence of aneurysm. A cinerentgen study showed paradoxical pulsation over the calcific area. The patient is still alive.

This case is shown as an example of demonstrated calcified ventricular aneurysm in a patient with long survival. Tr. Trachea. Ventricular calcification is seen anteriorly and inferiorly.

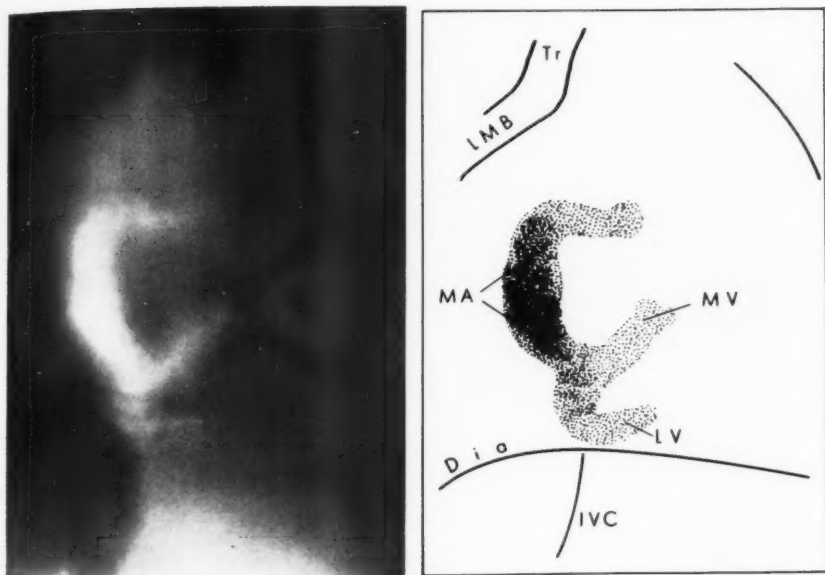


Fig. 13. Mitral annulus and left ventricular calcification (lateral laminagram).

C. E., a 67-year old white female, gave a long history of congenital hemolytic jaundice. No definite record of rheumatic fever was obtained, but the findings of mitral stenosis and atrial fibrillation with right bundle-branch block were apparent. There was massive calcification in the annulus and the immediately adjacent areas, and some in mitral leaflets, as well as in the left ventricle. This was confirmed at autopsy. Tr. Trachea. L.M.B. Left main bronchus. I.V.C. Inferior vena cava. M.A. Massive mitral annulus calcification. M.V. Mitral leaflet calcification. L.V. Left ventricular wall calcification.

others short parallel lines were seen not far from the aortic valve area.

**Intraluminal Calcification:** A single instance, of partially calcified thrombus (Fig. 11) was found in this series, appearing as a dense, solid calcification in the auricular appendage and as linear calcification within the thrombus in the atrium. Although there have been a few reports in the literature of calcification within both thrombus and tumor (2, 6), this is an unusual finding. The static calcification of thrombus would often be extremely difficult of recognition without laminagraphy.

**Ventricular Myocardial Calcification:** One case of myocardial aneurysm with calcification following myocardial infarction is illustrated (Fig. 12).

**Pulmonary Arterial Calcification:** Calcification of a thrombus in the left atrium and in the left pulmonary artery occurred in 1 instance (Fig. 11).

**Calcification of the Aorta:** One case of a calcific ring immediately above the area of

the aortic valve was encountered, which could be separated from valvular calcification by its appearance (Fig. 9). Rheumatic heart disease with aortic stenosis predominating was found postmortem. The calcification was shown to consist of a transverse row of vegetative calcific excrescences, just above the superior margins of the sinuses of Valsalva, associated with focal atheromatous degeneration. It is hypothesized that these excrescences are related to the disturbed hemodynamics of the rheumatic aortic valve lesion.

#### DISCUSSION

The experienced, well adapted fluoroscopist can find almost all of the calcifications discovered by laminagraphy. This procedure, however, does provide an additional check. In this series there has been no case of calcification suspected at fluoroscopy, which was not seen on laminagrams and found at autopsy or surgery. Laminagraphy has been of considerable help in



patients with very large hearts and in the presence of free pleural fluid in significant amounts. Frequently, unquestionable valvular calcification has been shown by laminagraphy that has not been recorded

is minimal and is helpful in distinguishing valvular from other calcifications. The identification of multiple valvular calcifications is greatly facilitated. A permanent record of the amount and location of the

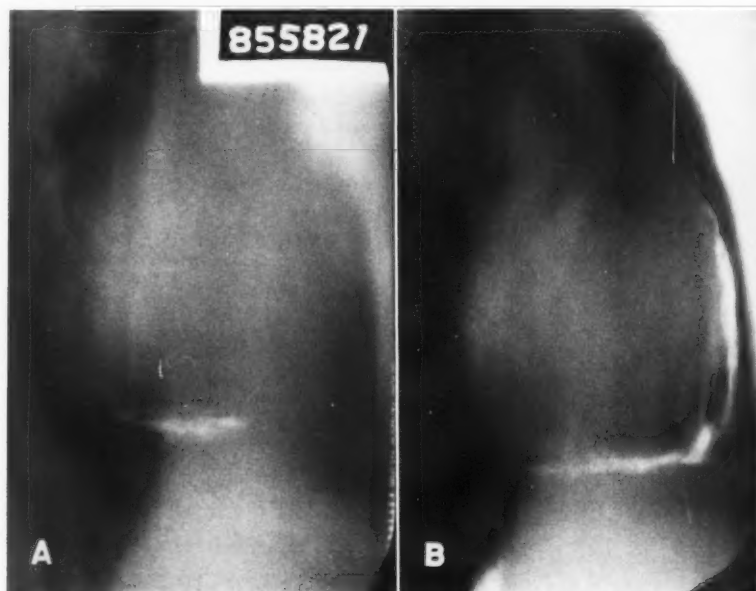


Fig. 14. Pericardial calcification with constriction (lateral laminagrams).

E. M., a white woman 32 years old, gave a history of scarlet fever but none of rheumatic fever. A variety of cardiac murmurs were heard, and the liver edge was 4 cm. below the costal margin. Left heart catheterization showed slight left ventricular failure effect. Right catheterization showed constrictive pericarditis, as did the fluoroscopy. At operation the calcified and ossified pericardium was found and removed. The patient has done well. The laminagrams were obtained before (A) and (B) after pericardectomy for constrictive pericarditis. Pericardial calcification is seen anteriorly and inferiorly.

at operation. At autopsy, however, the pathologist has found both gross and microscopic calcification not recognized laminagraphically. Differentiation of calcifications close to valves but not actually involving them, as in the case of the aortic ring, is not possible with fluoroscopy alone.

The single most important advantage of laminagraphy lies in the demonstration of multiple valve calcifications.

#### SUMMARY

Cardiac laminagraphy has been shown to be a clinically useful procedure. It provides confirmation of a fluoroscopic impression when the density at fluoroscopy

calcifications is provided and this record can be readily shown to conference groups. The bronchophrenic line for separation of mitral and aortic calcification is described.

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#### SUMMARIO IN INTERLINGUA

##### Laminographia Cardiac

Es demonstrate que laminographia cardiac es un technica de utilitate clinic. Illo provide confirmation de un impression fluoroscopic quando le densitate in le fluoroscopio es minimal. Illo es de adjuta in distinguere inter calcificationes valvular e altere. Le identification de multiple calcificationes valvular deveni multi plus facile. Un permanente documentation del quantitate e del loco del depositos calcific es providite, e iste documentation pote prestemente esser presentate a major e minor gruppos de conferentia.

Le linea bronchophrenic pro le separa-

tion de calcification mitral ab calcification aortic es describite. Iste linea se termina inferiormente al intersection de un tangente al superficie antero-cardiac con un tangente al superficie infero-cardiac. Le termino posterior (superior) es le superficie inferior del sinistre broncho major in le plano del section. Iste division non es infallibile, sed in 93 inter 102 casos con calcification le linea curvava anteriormente e superiormente con respecto a calcificationes del valvula mitral e posteriormente e inferiormente con respecto a calcificationes del valvula aortic.



## Roentgenologic Manifestations in the Lungs in Milk Allergy<sup>1</sup>

WILMA C. DINER, M.D., W. T. KNIKER, M.D., and DOUGLAS C. HEINER, M.D.<sup>2</sup>

A SYNDROME of chronic recurring upper respiratory and pulmonary infections apparently associated with ingestion of milk and milk products has been described by Heiner and Sears (1). It was felt advisable to call attention to the chest involvement and its roentgenologic manifestations in this condition.

Unusually high levels of precipitating antibodies to various cow's milk proteins were found by the workers cited above in the serum of infants with chronic respiratory disease. More than 2,000 patients were tested at random for the presence of these antibodies by exposing their sera to raw milk antigen by a modified double diffusion agar-in-gel technic (2). In 8 cases,<sup>3</sup> all in infants, 5 or more precipitation bands were demonstrated and severe clinical manifestations were present. Four of the group were shown by one of us (W. T. K.) to have strongly suggestive or positive laboratory evidence of idiopathic pulmonary hemosiderosis.

Clinically, the children described by Heiner and Sears had recurring or continuous episodes of coryza, cough, wheezing, and pneumonia. They displayed also gastrointestinal manifestations of varying degrees, as vomiting, diarrhea, abdominal pain, and poor weight gain. These findings were associated with the ingestion of cow's milk products. The age of onset of symptoms varied from thirteen days to sixteen months, being at or under four months in all but 1 child. In 7 of the children there was no evidence of tuberculous or fungous infection. In 1 a healed primary complex was demonstrated on the chest roentgenogram, but old tuberculin (5 T.U.) and histoplasmin (1:100) skin tests were negative at forty-eight hours in all. Cystic fibrosis was also ruled out. The

accompanying graph (Fig. 1) illustrates the incidence of the various clinical manifestations of the syndrome in 7 of the 8 patients. The eighth child was never completely evaluated because all attempts to induce his family to bring him back to the hospital after the first visit were futile. His history included cough of one week duration, tachypnea, fever, anorexia, and vomiting. He was pale and irritable, and exhibited physical signs of pneumonia; anemia, leukocytosis, and marked eosinophilia were present.

The natural course of this disease is not definitely known, since recognition and treatment of the first case are of such recent date, the autumn of 1959. Three patients became asymptomatic spontaneously at the ages of fourteen, twenty-one, and thirty months, even though circulating precipitating antibodies were still present. In 4 patients still symptomatic, the withdrawal of milk products and, to a lesser extent, boiling of the milk before feeding improved or completely cleared the symptoms. One child of the last group was still having symptoms at thirty months of age, but became asymptomatic on milk substitute.

### ROENTGEN FINDINGS

The chest roentgenograms of these infants showed a variable pattern from a mild peribronchial infiltrate to patchy, segmental, and even lobar consolidation. The densities shifted in pattern, location, and intensity from one time to another in a given patient, but the lung fields were never seen to be completely clear during the illness. Some degree of atelectasis was often present. Three patients showed pleural thickening. In 2 there was a mild constant underlying reticular pattern of density.

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<sup>3</sup> The published abstract (1) lists only 7 cases, but actually there were 8, the last having been found after the abstract was submitted.

**SYMPTOMS AND SIGNS**

	1	2	3	4	5	6	7	8
POOR WEIGHT GAIN .....								
CHRONIC COUGH .....								
RECURRENT PNEUMONIA .....								
RALES AND WHEEZES .....								
FAMILY HISTORY OF ALLERGY .....								
PALLOR .....								
CHRONIC RHINORRHEA .....								
FREQUENT VOMITING .....								
FREQUENT DIARRHEA .....								
RECURRENT OTITIS .....								
PALE, BOGGY NASAL MUCOSA .....								
HEMOPTYSIS .....								

**LABORATORY**

ANEMIA, IRON DEFICIENCY TYPE .....								
BLOOD EOSINOPHILIA .....								

**Fe LADEN MACROPHAGES**

DEFINITE .....								
QUESTIONABLE .....								
NEGATIVE .....								
NOT TESTED .....								

**SKIN TESTS TO RAW MILK 1-10,000 DILUTION**

STRONGLY POSITIVE .....								
WEAKLY POSITIVE .....								

**CHEST ROENTGENOGRAMS (all eight patients)**

ABNORMAL .....								
PATCHY INFILTRATE .....								
ATELECTASIS .....								
SEGMENTAL OR LOBAR CONSOLIDATION .....								
PERIBRONCHIAL INFILTRATE .....								
ENLARGED LYMPH NODES .....								
PLEURAL THICKENING .....								
RETICULAR UNDERLYING CONSTANT PATTERN .....								
EMPHYSEMA .....								

**SHIFTING ON SEQUENTIAL ROENTGENOGRAMS**

PRESENT .....								
ABSENT .....								
NO FOLLOW-UP .....								

Fig. 1. Incidence of various clinical manifestations of milk allergy in 7 patients. Findings in an eighth case were incomplete.

Coincident with symptomatic improvement, the roentgen findings, except for the reticular pattern, cleared partially or completely. This was true regardless of whether such improvement was spontaneous or followed exclusion of cow's milk products from the diet. Milk was reintroduced in 2 patients. In 1, symptoms recurred without reappearance of pulmonary infiltrates. In the other, marked infiltrates reappeared, though the child remained asymptomatic.

**CASE REPORTS**

**CASE I:** D. B., a white male seen first at the age of eight months, for whom films spanning a period of about fifteen months were obtained (Fig. 2). During an acute illness in July 1959, patchy and streaky infiltrates were seen in both lungs, with a generalized fine underlying mottling and reticular lacework. Symptomatic improvement a week later preceded roentgenographic clearing. During a clinical relapse in September 1959, with grunting respirations, retraction, and fever, atelectatic streaks appeared in the right upper lobe. At this time the diagnosis of hemosiderosis was suggested; a few macrophages containing iron pigment were found in

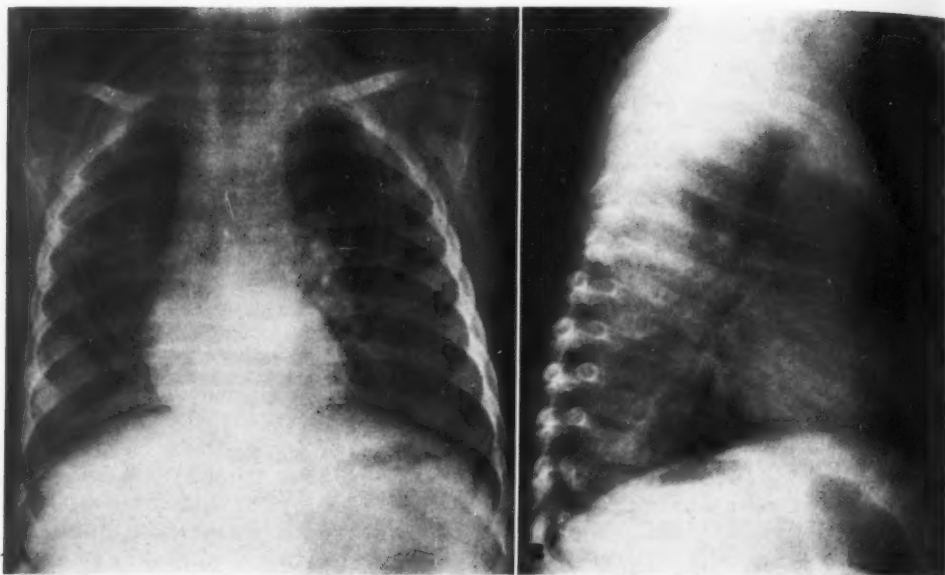


Fig. 2, A and B. Case I. July 31, 1959. Postero-anterior and lateral views. Scattered patchy and streaky densities in the medial portions of both lungs, especially in the posterior segment of the right upper lobe, with a generalized fine underlying mottling and reticular lacework. See also Fig. 2, C-F, on opposite page.

the bronchial aspirate. The atelectasis subsequently cleared, but the underlying mottling remained. On Oct. 1, 1959, milk was eliminated from the patient's diet at home and he shortly became asymptomatic and remained so. During June 1960, he was again given milk; a few days later he began to wheeze and cough. These symptoms persisted until milk was withdrawn, when for a second time he became asymptomatic. The child was not seen at the hospital between September 1959 and August 1960. At the latter date there remained a slight generalized mottling of the lungs, which were otherwise clear. Beginning Oct. 1, 1960, evaporated milk was given daily. About one week later a slight intermittent cough developed but the films remained unchanged. Milk substitute was then prescribed, to be maintained indefinitely.<sup>4</sup>

**CASE II:** C. B., an 8-month-old colored female. Chest roentgenograms (Fig. 3) between March 25, 1959, and April 21, 1960, showed patchy pneumonic infiltrates in different areas of the lungs, though on one occasion (July 2, 1959) within that period almost complete clearing was demonstrated. Beginning in February 1960, when a diagnosis of hemosiderosis was made by lung biopsy, the child

was given only boiled milk to drink. There was incomplete symptomatic improvement and partial clearing of the lung infiltrates, with the appearance of new infiltrates about five months later. All cow's milk was removed from the diet on July 14, 1960, and soy milk was substituted. Two weeks later the patient became asymptomatic and has remained so. Six weeks after exclusion of milk from the diet the chest roentgenogram was completely clear for the first time.

**CASE III:** L. B., a 21-month-old colored male. The chest roentgenograms (Fig. 4) from Dec. 2, 1959, until April 7, 1960, showed a changing pattern of pneumonic infiltrates and hilar and paratracheal lymph node enlargement. On two occasions the lungs were almost clear. A film on July 11, 1960, three months after withdrawal of milk from the diet, showed a relatively clear state, coincident with disappearance of symptoms. This was the longest period which had elapsed without an acute episode of pneumonia. The right paratracheal shadow, which may be the thymus, persisted. There was slight underlying streaking, not characteristic of hemosiderosis, although hemoptysis occurred. A diagnosis of pulmonary hemosiderosis was made from gastric washings in April 1960. In July 1960, the parents restored cow's milk to the diet. The patient remained asymptomatic except for a mild upper respiratory infection about one week before the radiograph of Oct. 20, 1960, which showed a striking recurrence of pulmonary infiltrates.

<sup>4</sup> Since this manuscript was submitted for publication, the patient was fed whole milk on a trial basis on several occasions, with reappearance of wheezing and cough. Since July 15, 1961, however, homogenized milk, 1 quart daily, has been tolerated without symptoms, and chest roentgenograms have not changed.

Fig. 2  
Atelectasis  
and mottling  
E. S.  
by a milk  
F. A.  
asymptomatic

CASE  
mongoloid  
21 and  
atelectasis  
symptoms  
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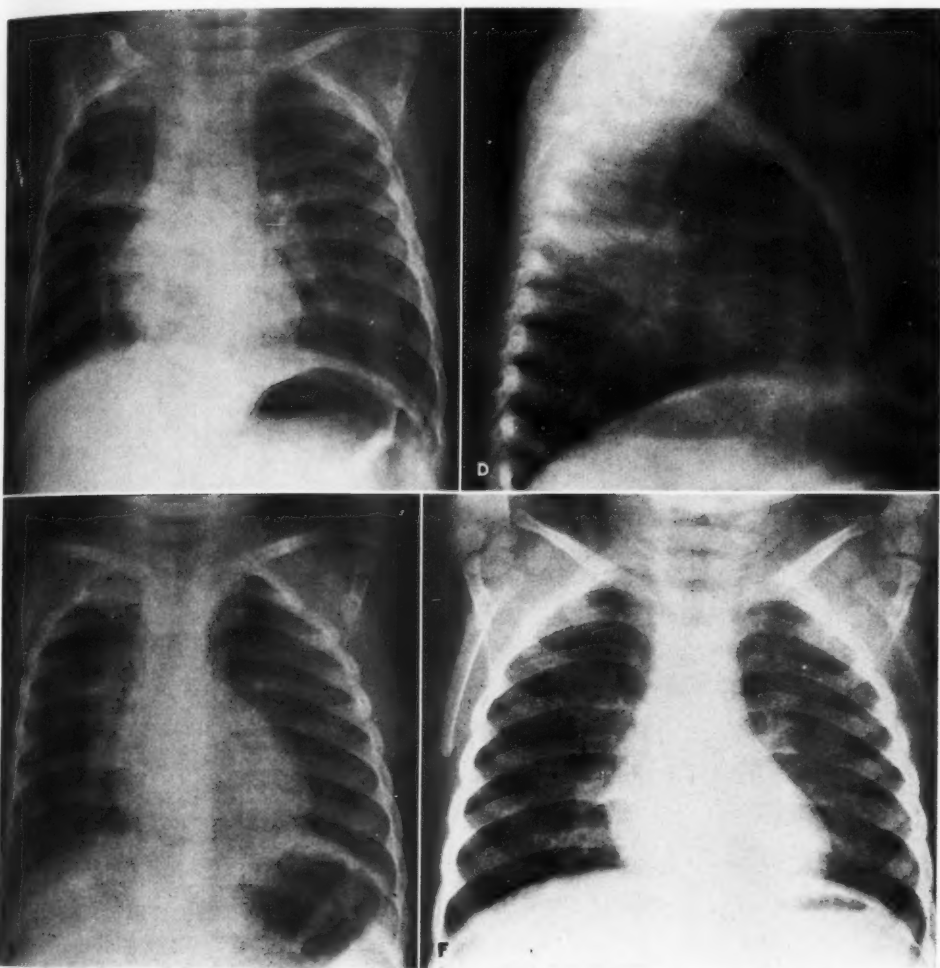


Fig. 2, C-F. Case I. Sept. 17, 1959. C and D. Postero-anterior and lateral views during a clinical relapse. Atelectatic streaks in the anterior and posterior segments of the right upper lobe. The underlying reticulation and mottling remain. The diagnosis of hemosiderosis is made.

E. Sept. 24, 1959. The underlying pattern remains, although the atelectasis has cleared. Milk was replaced by a milk substitute Oct. 1.

F. Aug. 9, 1960. Slight residual general mottling, but the lungs are otherwise clear. The patient has been asymptomatic since mid-October 1959.

CASE IV: D. M., an 18-month-old colored mongoloid girl. Roentgenograms (Fig. 5) of May 21 and July 7, 1958, showed severe pneumonia with atelectasis and pleural thickening or fluid. The symptoms and roentgenographic findings cleared spontaneously between Jan. 9, 1959, and May 12, 1960, and subsequent roentgenograms remained normal.

CASE V: R. M., a 2-year-old white male. This is a relatively mild case with a slight bronchopneumonic pattern and some enlargement of the hilar and right paratracheal lymph nodes. The

child remained symptomatic and roentgenograms showed little change from Jan. 8 until June 13, 1960, even though all his milk was boiled after Feb. 1. On June 13, 1960, milk was eliminated from the diet. The examination of July 14, 1960, was normal. Since mid-August, the boy has drunk about a quart of raw milk daily but has remained asymptomatic and his chest roentgenograms are normal.

#### DISCUSSION

Allergy to cow's milk has been recognized for many years as a problem, par-

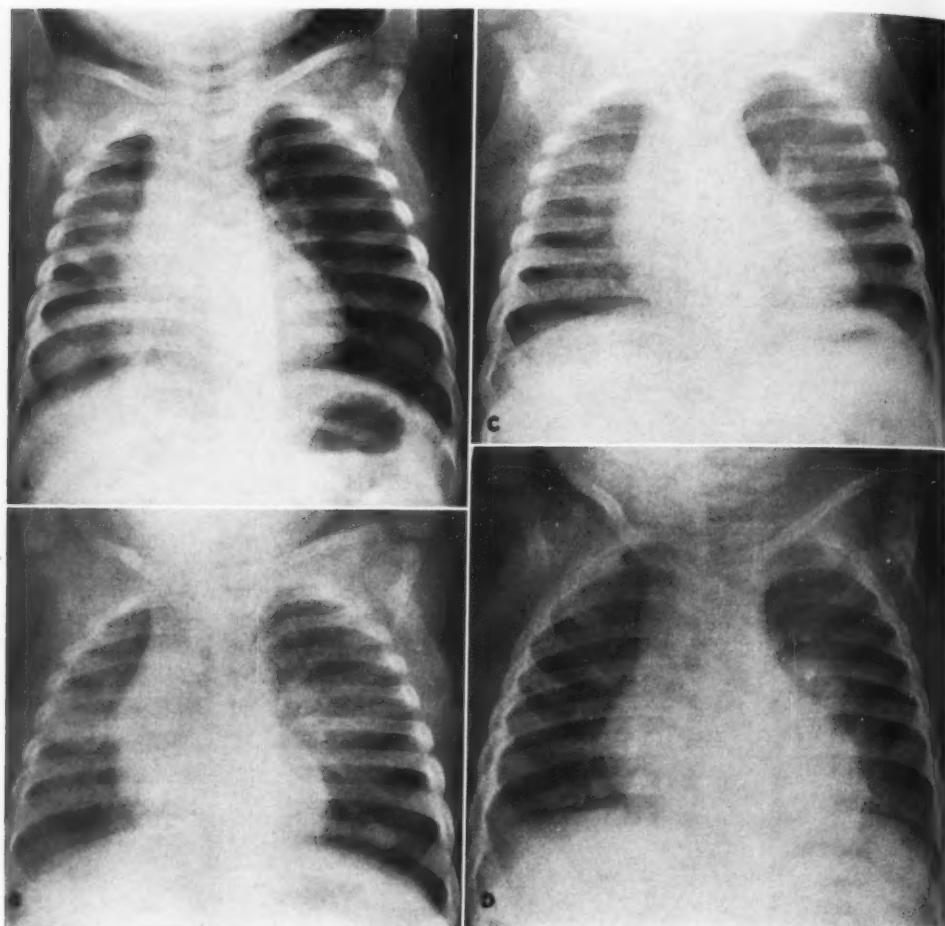


Fig. 3. Case II. A. March 25, 1959. Patchy density in the right upper, middle, and lower lobes; some shift of the mediastinum to the right; slight peribronchial infiltrate in the left lung and a questionably enlarged right paratracheal lymph node.

B. May 25, 1959. Relapse after symptoms cleared clinically and roentgenologically. Now the bilateral infiltrate is mostly in the superior segments of the lower lobes.

C. July 2, 1959. Almost complete clearing.

D. Jan. 20, 1960. Radiological relapse with scattered patchy infiltrates. Hemosiderosis was diagnosed by lung aspiration in February 1960, and all milk was boiled from February to July.

ticularly of infancy, with a reported incidence of 0.3 to 8.0 per cent (3-5). The clinical manifestations are not clearly defined but have been presented by Collins-Williams (3), Clein (6), Davies (7), and Kaufman (8). Symptoms are usually present in the first months of life, with a tendency to disappear spontaneously by the age of two. While allergic rhinitis, asthma, and severe tracheobronchial disease have been described, chronic respiratory disease

characterized by recurrent pneumonia and persistent migratory infiltrates on chest films has not been previously recognized. Hematemesis and hemoptysis have been noted (4, 6, 7). Actual proof of underlying milk allergy has not been clear in most instances. Skin sensitivity, for instance, can be demonstrated in many normal babies not even exposed to milk and bears a poor relationship to the presence of symptoms of significant milk allergy (8, 9).

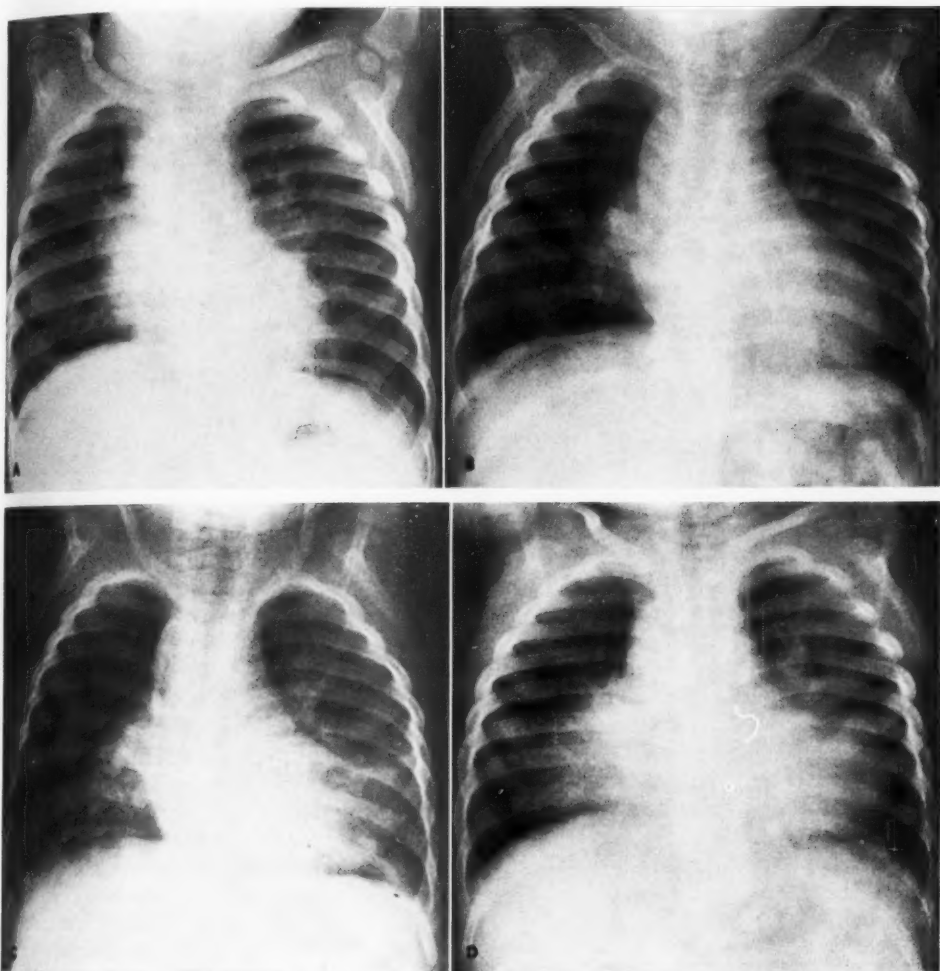


Fig. IV. Case III. A. Dec. 12, 1959. Patchy perihilar density bilaterally, with dense infiltrate in the right middle and lower lobes and in the left lower lobe. Questionably enlarged right hilar and right paratracheal lymph nodes. Sharp outline of lateral margin of density on the right, suggesting an element of atelectasis.

B. Jan. 15, 1960. Improvement in the infiltrate. The right paratracheal node is larger.

C. Feb. 15, 1960. Right lower lobe pneumonia with consolidation in the left lower lobe and lingular segment of the left upper lobe. In a roentgenogram obtained on April 7 the lung had cleared with an appearance comparable to that in B. Diagnosis of milk allergy was then made. Cow's milk was withdrawn from the diet and soy milk substitute was given.

D. Oct. 20, 1960. Recurrence of right middle lobe, lingular, and bilateral lower lobe infiltrates, worse than at any previous time. Parents had restored cow's milk to the diet in July. The patient had remained asymptomatic in spite of the change in the roentgen picture.

Newer research tools such as electrophoresis and gel diffusion have resulted in clarification of the immunological mechanisms in milk allergy (10-12). Most clinical allergy has been found to be secondary to sensitization by the lactalbumin fraction.

In 1925, Anderson *et al.* demonstrated

both positive skin tests and circulating precipitins to milk in the majority of infants fed cow's milk soon after birth (13). These were transient and unrelated to clinical disease. In the immunologic tests employed in the study of our patients, a microscopic slide for agar diffusion and 0.05 ml. volumes of reactants

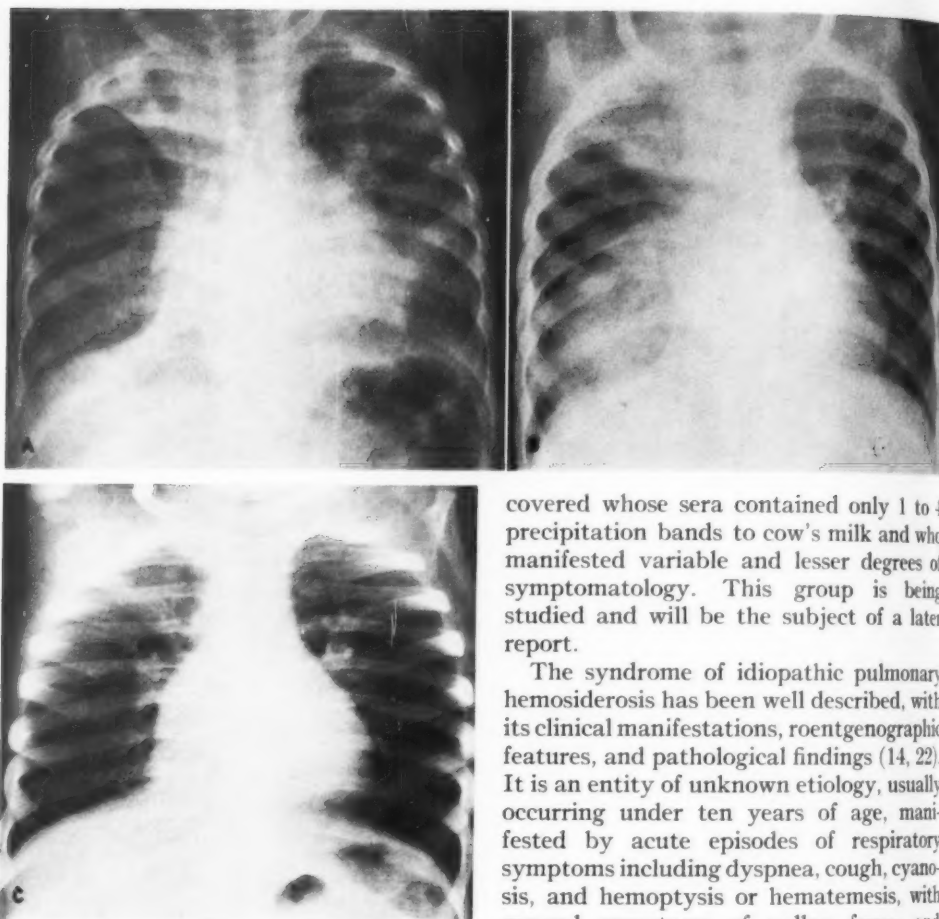


Fig. 5. Case IV. A. May 21, 1958. Bilateral widespread patchy infiltrate. Atelectasis in right upper lobe and right lower lobe. Pleural thickening (? fluid) around left lung. Compensatory emphysema in right middle lobe. Diaphragm flat.

B. July 7, 1958. Compensatory emphysema less prominent. Marked consolidation with air bronchogram in the right upper and lower lobes, with some right lower lobe atelectasis and thickening of major fissure. Pleural thickening on left is almost gone.

C. Jan. 9, 1959. Lungs clear except for some residual streaking in right upper lobe. The patient became spontaneously asymptomatic in the early summer of 1959 and a roentgenogram on May 12, 1960, was normal.

were utilized. The intensity and number of precipitation bands observed suggests a high titer of antibodies, and the presence of such bands seems to be correlated with the presence of severe clinical disease.

Beside the 8 children in this series, approximately 30 patients have been dis-

covered whose sera contained only 1 to 4 precipitation bands to cow's milk and who manifested variable and lesser degrees of symptomatology. This group is being studied and will be the subject of a later report.

The syndrome of idiopathic pulmonary hemosiderosis has been well described, with its clinical manifestations, roentgenographic features, and pathological findings (14, 22). It is an entity of unknown etiology, usually occurring under ten years of age, manifested by acute episodes of respiratory symptoms including dyspnea, cough, cyanosis, and hemoptysis or hematemesis, with general symptoms of pallor, fever, and weakness. It is generally considered a progressive disease, but long remissions have been reported (15, 19, 20). Death is usually of a cardiorespiratory nature, but is sometimes due to acute hemoptysis and pneumonia.

Variable findings on chest roentgenograms have been described in idiopathic pulmonary hemosiderosis. Most common is an underlying fine reticular, reticulostriate, or moss-like pattern which progresses in intensity with each subsequent clinical exacerbation. This pattern is due to deposition of hemosiderin and siderophages in the septa and lymphatic systems of the lung. With each episode, soft fluffy patches of density, shifting in location, are superimposed, presumably representing in-

intermittent intrapulmonary hemorrhages.

Idiopathic pulmonary hemosiderosis was considered initially in 5 of the patients in the present series before their milk precipitins were discovered. It was substantiated later in 3 children, probably in 4. While none of the milk allergy roentgenograms exactly resembled those of idiopathic pulmonary hemosiderosis, in 3 cases moderate numbers of iron-laden macrophages were found in bronchial washings, gastric washings, or lung aspirates. In a fourth child (Case I) a few macrophages containing iron pigment of questionable significance were demonstrated. An underlying reticular pattern similar to that described above (page 570) was seen in 2 cases (see, for example, Fig. 2).

While the cause is still in doubt, one of the most recent theories concerning the pathogenesis of hemosiderosis assumes the formation of antibodies against a sensitizing agent and their selective concentration in alveolar walls (21). When the allergen circulates, the resultant antigen-antibody reaction is responsible for the pulmonary hemorrhages. Evidence has been cited supporting this explanation (22), but no one has demonstrated such an allergen. The cases herein reported strongly suggest that milk proteins are capable of initiating this sequence of events. "Allergic" pneumonitis, related to many different conditions, has been recognized (23).

An additional interesting patient, a 10-year-old colored male with persistent asthma, is being observed at the University of Arkansas Medical Center. A year ago iron-laden macrophages were found in his bronchial washings. Recently the test for milk antibodies in the serum demonstrated several weak precipitation bands. On chest roentgenograms over a 16-month period, there are patchy migrating areas of perihilar and parenchymal density representing inflammatory infiltrates, with a suggestion of hilar lymph node enlargement intermittently. The last film, obtained on Sept. 1, 1960, about two years after the first examination, was normal for the first time.

#### SUMMARY

A group of infants shown to have high levels of precipitins against cow's milk manifest a characteristic syndrome of chronic cough, dyspnea, and wheezing, with recurrent episodes of pneumonia. Frequently other respiratory and gastrointestinal symptoms and iron deficiency anemia are also present. These findings disappear soon after withdrawal of milk products from the diet.

Pulmonary hemosiderosis was found in 4 of the 8 cases discussed. It is intriguing to implicate milk allergy as one possible cause of this "idiopathic" syndrome. Indeed, one of the primary etiologic theories has been that of a hyperimmune reaction in the alveolar walls to some unknown allergen; milk protein appears to be such an antigen.

We feel that it is important for radiologists to recognize the possibility of milk allergy as a cause of chronic and recurrent respiratory and gastrointestinal illness in infants who show a non-specific and variable pattern of pneumonias, as illustrated here. It is also hoped that patients who have the clinical picture here described or a diagnosis of pulmonary hemosiderosis will be studied for circulating milk antibodies. If present, these constitute a definite indication for removal of cow's milk and milk products from the diet.

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## SUMMARIO IN INTERLINGUA

## Manifestationes Roentgenologic in le Pulmones in Allergia pro Lacte

Un gruppo de infantes, demonstratemente con alte nivellos de precipitinas contra lacte de vacca, manifesta un syndrome characteristic de chronic tusse, dyspnea, rhoncho, e recurrente episodios de pneumonia. Le roentgenogramma thoracic in tal casos monstra un variabile configuration, ab leve grados de infiltration peribronchial usque ad formas maculate, segmental, e mesmo lobar de consolidation. Le densitates in le patiente individual varia in configuration, sito, e intensitate ab un examine al altere, sed il nunquam occurre durante le maladia que le campos pulmonar es completamente clar. Un certe grado de atelectasis es frequentemente presente. Le constataciones clinic dispare tosto post le

suspension de productos de lacte in le dieta. In coincidentia con le melioration symptomatic, etiam le constataciones roentgenographic—con le exception del configuration reticular—se acclara in parte o completamente.

Hemosiderosis pulmonar esseva trovate in 4 inter le 8 casos discutite. Es fascinante specular que possiblemente allergia pro lacte es un causa de iste idiopathia.

Es sperate que patientes con un tableau clinic del typo hic describe o con un diagnose de hemosiderosis pulmonar va esser studiate pro circulante anticorpo anti lacte. Si tales es presente, le suspension de lacte de vacca e de productos lactee ab le dieta es definitemente indicate.

# Cineurethrography and Voiding Cinecystography, with Special Attention to Vesico-Ureteral Reflux<sup>1</sup>

KENNETH E. GROSS, M.D., and STEVENS S. SANDERSON, M.D.

THE OBJECT OF this presentation is threefold: first, to show the capabilities of the cinefluorographic method in evaluating lower urinary tract disease in children and adults, incidentally discussing the method of accomplishing such an examination; second, to review vesico-ureteral reflux as an entity by case presentation and thus illustrate the advantages of the cine method; third, to present some suggested clues to vesico-ureteral reflux offered by observation of the excretory urogram or retrograde study.

## METHOD

A 16-mm. synchronized motion picture camera with an 8-inch amplifier and a film exposure speed of 7.5 frames per second was used for all the cineradiographic studies. The exposure factors depend upon the patient's size and are in general adjusted automatically by photocell circuitry. Upon these the r-output to the individual is obviously dependent. Individual and phantom readings and calculations of gonadal dose indicate an average range of 1.1 r, plus or minus 25 per cent. This compares favorably—and is rather consistently somewhat less—with the dose from a conventional examination by a series of 5 films with every effort to minimize the amount of irradiation. The small field size is also in favor of the amplifier and cinefluorographic method in this respect. All determinations are notably limited in accuracy by the multiple factors emphasized by Morgan (1).

Early attempts were made with media introduced into the bladder by excretory urography to avoid irritation of the urethra when a urethral problem was anticipated. This was satisfactory, but from a practical point of view we have concluded that a small catheter does not cause sufficient irri-

tation or alteration in urethral physiology to be of significance. The opaque material has therefore been introduced in this manner in the majority of our cases.

Establishment of good patient rapport preceding the examination is of extreme importance in avoiding emotional factors interfering with micturition at the desired time.

The opaque material is any one of the readily available intravenous injectable water-soluble media diluted to a 15 per cent solution of iodine. This has proved to be completely non-irritating. Low-specific-gravity Lipiodol has been useful in certain cases in demonstrating reflux after a twenty-four-hour bladder retention, and we are at present combining 5 c.c. of that preparation and 5 c.c. of hyperbaric Lipiodol with the water-soluble medium. This creates an "opaque sandwich," with oily media above and below the water-soluble material, affording the advantages of oily media for visualization of the urethra without the dangers and disadvantages associated with their use in ascendant urethrography (2, 3).

Filling is accomplished to the point of full sensation on the part of the patient, but not beyond this. There have been no complications in the form of temperature elevation or other manifestations of untoward reaction.

Films are obtained at the time the contrast agent is introduced. Exposures in bursts are used to eliminate unnecessary roentgen dosage to the patient.

A delay period of about three hours is allowed in most cases because of reports of increased incidence of reflux after delay (4, 5). Only on rare occasions, however, does reflux occur solely on delay, though this has been demonstrated (Fig. 7, C). It is emphasized, however, that reflux

<sup>1</sup>From the Department of Radiology, Mary Bridge Children's Hospital, Tacoma, Wash. Presented at the Forty-sixth Annual Meeting of the Radiological Society of North America, Cincinnati, Ohio, Dec. 4-9, 1960.



Fig. 1. Spastic neurogenic bladder. Cinecystogram of a nine-year-old hydrocephalic boy. Markedly trabeculated, spastic neurogenic bladder with absence of urethral sphincter control and reflux on the right, with dilatation of the ureter in the lower third.

may occur at any time during the entire examination and the *time is completely unpredictable*.

Following delay, the initiation of voluntary micturition and its cessation are attempted. During the voiding stage the urethral portion of the bladder, the dome, and the lower ureters are all visualized. The male patient is placed in a steep right oblique position with elevation of the flexed right leg. In the female, the urethra is demonstrated in the frontal projection and, if possible, also in the oblique. Recording on film is continued throughout the entire act of voiding until the final residue is obvious. At this time a scan of the ureters and the kidneys is repeated, this having been accomplished at least once before at the time of total bladder filling and delay.

We have varied the position and have concluded that the erect one is to be preferred in both male and female, if adaptable to the individual. A radio-lucent plastic funnel and plastic tubing leading to a jug on the floor have served admirably as a urinal.

Cineradiography allows excellent visualization of the normal organic structure and behavior of the urethra and bladder during voiding, and over the past thirty years the knowledge of normal physiology

has been greatly aided by this means (6, 7). It is equally valuable in the study of patho-physiologic states of these structures.

#### VESICO-URETERAL REFLUX

While studying the lower urinary tract, we were most impressed with the ability of cineradiography to demonstrate vesico-ureteral reflux. Though the importance of reflux is not completely agreed upon, we believe that it is a most urgent problem and that its discovery and demonstration are beyond doubt of importance. The cinefluorographic method is most valuable here, for certain examples of reflux will escape detection unless nearly constant surveillance is exercised.

There is general agreement that vesico-ureteral reflux is not a normal phenomenon in persons without urinary symptoms (8-13). Some 425 cases have been reported in patients admitted to study for other than urinary complaints and considered to be entirely normal as far as the urinary tract was concerned. The opportunity to investigate entirely normal persons in this fashion has not been afforded us.

For many years vesico-ureteral reflux has been known to occur (14), and its physiologic and anatomic mechanisms have been theorized upon and clinically and experimentally observed (14, 15). The number of suggestions as to its mechanism seems to be limited only by the number of interested authors writing on the subject. The presentation to follow will attempt to show the advantages of the radiographic approach to the problem. Only such anatomic and physiologic changes as are radiographically obvious will be considered.

All previous authors discussing this subject have emphasized the high incidence of normal excretory urograms. It is agreed that in many cases the excretory urogram does appear normal; however, certain clues serving to arouse suspicion of possible vesico-ureteral reflux are detectable. The material to follow is presented to illustrate these. It is from a series of 83 cineradiographic studies, with a 47

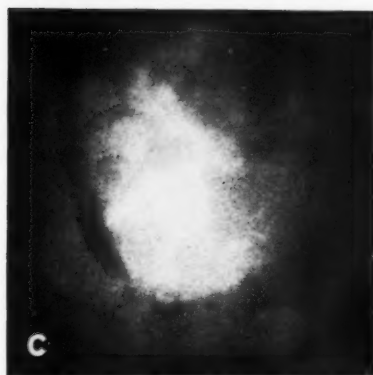
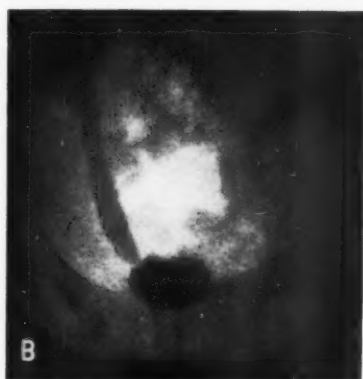


Fig. 2. Congenital abnormality at the vesico-ureteral junction in a twelve-year-old girl. Repeated episodes of low-grade fever and fatigue and of urinary tract infection. Duplication of the cervix and bifid uterus. Duplication of the left ureter and calyceal system.

A. Excretory urogram: Mild ureterectasis on right, with narrowing at the vesico-ureteral junction.

B. Cinecystogram during filling. With only a small amount of medium in the bladder, there is immediate reflux into the dilated right ureter. Note apparent space or notch between the partially filled ureter and the bladder.

C. Cinecystogram on completion of voiding. Small residue in bladder and persistent notch and mucosal sacculus with ureteral retention. Other portions of this study show reflux up one of the duplicated ureters on the left side.

per cent incidence of vesico-ureteral reflux. This high incidence is ascribed to the clinical selection of all cases before cystography and an increasing index of suspicion based upon some of the clues. The positive percentage is slightly higher than was achieved by conventional study on a like

group, but the percentage difference is not large enough to be statistically valid. Nevertheless, it is our opinion from some individual cases that the cine method is more rewarding.

*Neurogenic Bladder:* The neurogenic bladder is well documented in the litera-

ture (16, 17) and cineradiography offers no distinct advantage over conventional filling, delayed, and voiding cystograms in the great majority of these patients, in whom reflux is so common. A spastic neurogenic bladder with characteristic "Christmas tree" deformity so-called, is illustrated in Figure 1. *Achalasia of the ureter* has been placed within this group, and it is felt that the only dependable method of making the diagnosis, short of histologic examination, is cineradiography, which serves to demonstrate the presence or absence of peristalsis in the involved segment. No other procedure is capable of accurately demonstrating the absence of peristalsis required for unequivocal diagnosis (18, 19).

*Congenital Abnormality at Vesico-ureteral Junction:* Congenital anomalies or developmental deformities of the trigone or placement of the ureteral orifice are so frequently associated with vesico-ureteral reflux that a patient with ureteral duplication or other congenital deformity apparent on the excretory urogram and with clinical evidence of repeated urinary tract infection should be subjected to vesico-urethrography (Fig. 2, A). In these persons the demonstration of any obstructive phenomenon at the bladder outlet is frequently impossible. It is emphasized that from a radiographic aspect excretory urographic findings are the clue to the ureteral reflux. Figures 2, B and C, illustrate the fact that the reflux may occur at any time in the cystographic cycle of events: at filling, upon delay, or at voiding. In this group of patients, cinecystography has a definite advantage over the conventional examination because of its "constant surveillance" at all degrees of bladder pressure. It is recognized that intravesical pressure is in many instances a factor in causing reflux (20).

Figure 2 illustrates the case of a twelve-year-old girl in whom measurements by catheter after voiding revealed bladder residual when, in truth, the bladder emptied well (Fig. 2, C). The urine was stored in the ureter and returned to the bladder

before the "after-voiding residual" was measured by catheter. This condition was also seen in an adult female (Fig. 5, C) and in other small children (Figs. 7, A and D; 10, B).

*Congenital Renal Hypoplasia:* A small kidney, assumed to be hypoplastic or underdeveloped, with poor function on excretory urography, may reflect a change secondary to vesico-ureteral reflux of long duration during early growth and development. What appears to be a hypoplastic kidney may in truth be cicatrizing pyelonephritis or hydronephrosis secondary to ascendant infection and the altered pressure within the urinary tract. This is illustrated in Figure 3, A: The excretory urogram shows no detectable function on early films on the right side, and the right kidney is smaller than the left. Figure 3, B, a retrograde pyelogram, demonstrates a typical hypoplastic renal contour. Figures 3, C and D, voiding cinecystograms, show reflux on the right side, occurring only during voiding. The same type of hypoplastic contour is shown in Figure 7, B. Thus, the excretory urogram is once again an indication for cystographic study.

*Ureteropelvic Obstruction:* The appearance of ureteropelvic obstruction is well known. For a long time the condition has been ascribed to aberrant vessels or strictures at the ureteropelvic junction, and there is little doubt that these are responsible in a majority of cases. During the present study it has come to our attention that vesico-ureteral reflux with the appearance of ureteropelvic obstruction on the excretory urogram has an unusually high incidence. In a case such as is illustrated in Figure 4, F, in which a definite etiology for urethral obstruction is identified—a urethral valve (Figs. 4, B, C, D, and E)—it behooves one to consider the possibility that ureteral and pelvic dilatation are occasionally produced by the reflux phenomenon. The appearance of the ureteropelvic obstruction is due to normally located anatomic structures exerting extrinsic pressure only because of the

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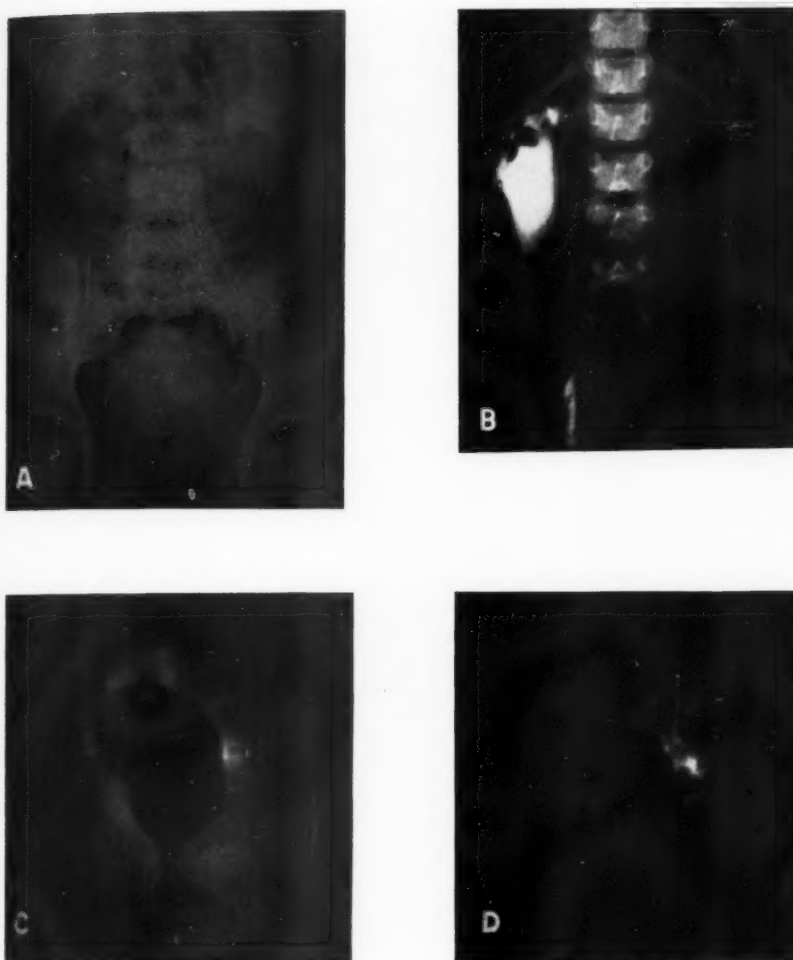


Fig. 3. Nonfunctioning right kidney in a boy six and a half years old, with recurrent urinary tract infection for two and a half years.

A. Excretory urogram, fifty-minute delay film. Note relatively large, well filled bladder, of essentially normal contour.

B. Retrograde pyelogram (right urinary tract) showing hypoplastic kidney contour.

C. Cinecystogram during voiding, demonstrating a large urethra with reflux up a dilated right ureter which is somewhat medially located. Note eccentric contraction of the bladder.

D. Cinecystogram on further emptying of the bladder. Note persistent reflux into right ureter and further emphasis of the abnormal bladder contour.

dilatation. The marked difference in the appearance of the right renal pelvis and the ureteropelvic junction on the excretory urogram (Fig. 4, A) and on reflux visualization (Fig. 4, F) indicates the anatomic change produced by the different physiological conditions: the excretory urogram without any altered pressure in the upper urinary tract and the cinecystogram with marked pressure change during voiding.

This is further illustrated in an adult in whom the same phenomenon with reflux was demonstrated (Fig. 5).

**Outlet Obstruction:** The fundamental clue to outlet obstruction is residual urine greater than the normal amount as seen on the excretory urogram after a voiding bladder study. Figures 4, A-E, illustrate this phenomenon well. Here, a urethral valve attached to the verumontanum and

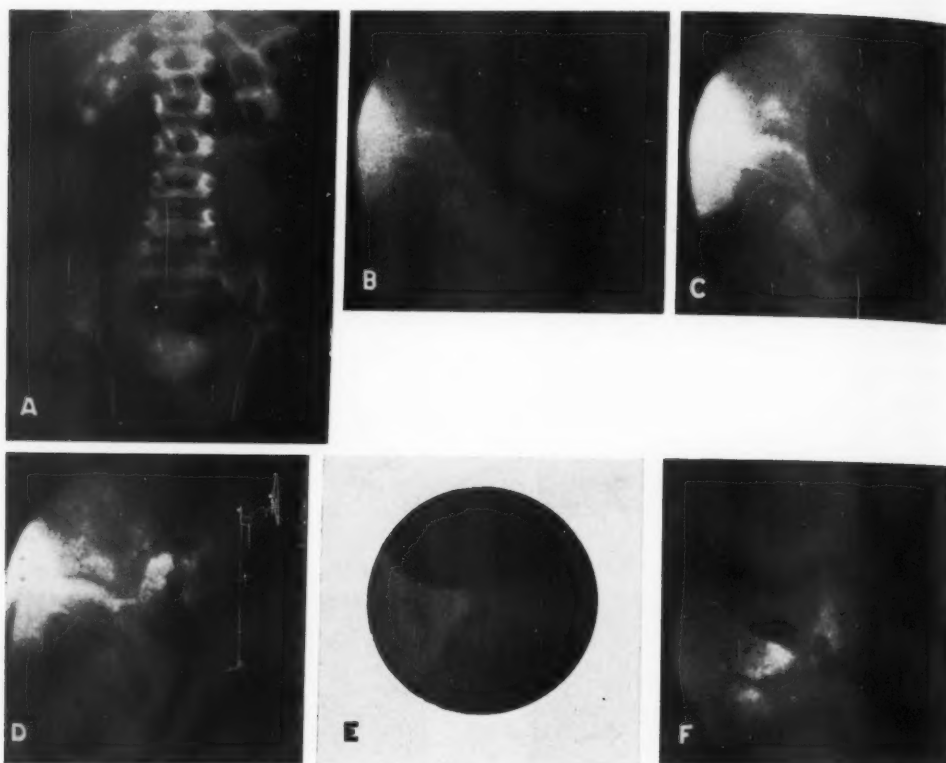


Fig. 4. Hydronephrosis in boy four and a one-half years old, with repeated urinary tract infections for eight months.

A. Excretory urogram. Dilated lower third of the right ureter with a notch and mucosal sacculi seen through the bladder.

B. Cinecystogram, during voiding (right anterior oblique position). Note persistent deformity in the prostatic portion of the urethra. There is immediate reflux up the right ureter when voiding is started.

C. Cinecystogram, during voiding (later stage than B). The persistent deformity of the urethra is still present. Reflux up both ureters is seen, more obvious on the right in this projection.

D. Cinecystogram at termination of voiding. The persistent deformity at the prostatic portion of the urethra is reasonably characteristic of a valve attached to the verumontanum. The persistence of the deformity is emphasized, for this type of deformity is seen in some cases on isolated frames in various stages of voiding. Similarly, isolated films made by conventional methods during voiding may lead to false conclusions regarding such deformities. This confirms the advantage of cineurethrography, where the entire voiding phase is visualized. The film strip obtained will consist of many individual exposures which may be viewed in motion as a sequence or individually as static films.

E. Enlarged section of a single cine exposure, showing the urethral deformity at the level of the verumontanum.

F. Cineradiograph of the ureteropelvic region. The caliectasis and ureterectasis are emphasized, possibly aiding in the distinction between this apparent obstruction and the more usual stricture or aberrant vessel. Note that the excretory urogram (A) shows a very little ureterectasis, markedly emphasized by the voiding cystograms (B, C, and D). The latter is believed to be the more accurate picture as it demonstrates the ureter and renal anatomy under the true physiologic circumstances of voiding. What appeared on the urogram as hydronephrosis is now seen to be ureteropelvic "obstruction" due to the back-pressure and distention of the ureter and renal pelvis.

some dilatation of the urethra in the internal sphincter region are demonstrated on cine-urethrography, accounting for the after-voiding residual. The interference with bladder emptying *via* the urethra has been repeatedly claimed as the major cause of vesico-ureteral reflux, as either a direct source of increased intravesical

pressure or an underlying cause of repeated vesical infection and secondary changes at the vesico-ureteral orifice (5, 13).

An unusual urethra-obstructing mechanism is illustrated in Figure 6, serving to emphasize the importance of cine-urethrography. Here, although the diverticulum causes eccentricity of the bladder

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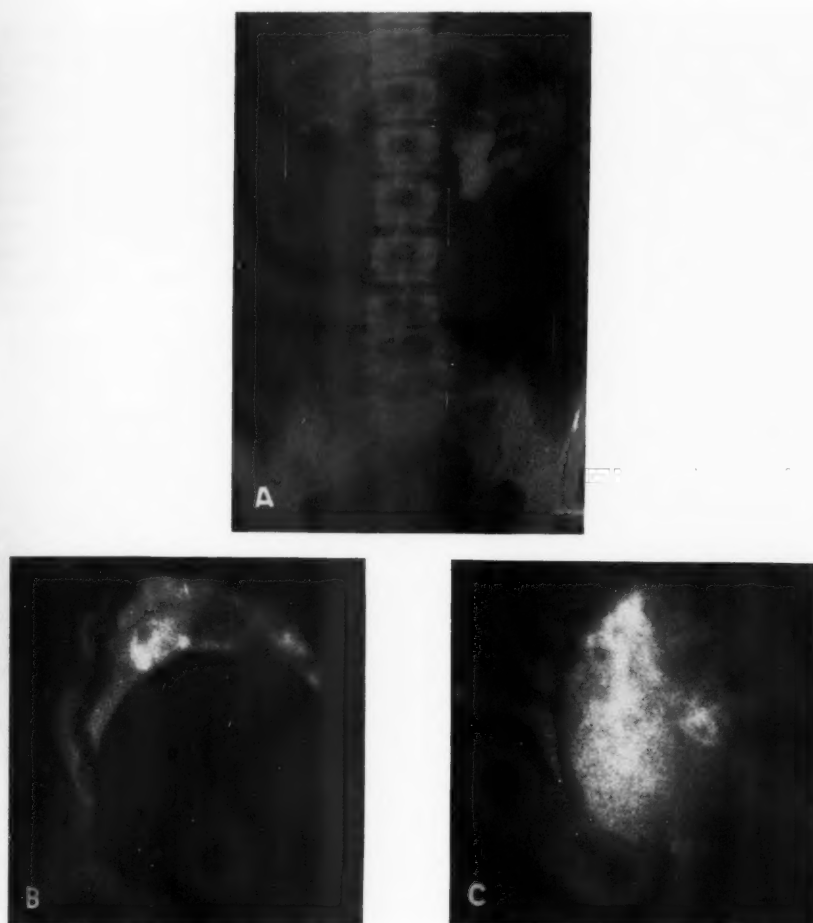


Fig. 5. Ureteropelvic obstruction in a woman twenty-four years old, with two children. For the past two years and a half she had experienced pain radiating up the right side when voiding only.

A. Excretory urogram, prone. Note bilateral ureteropelvic obstruction, emphasized in this position. It is more obvious on the left side, but the patient's complaints were confined to the right.

B. Cinecystogram. Reflux into the ectatic right ureter. The pain was reproduced at the moment reflux occurred. A mucosal saccule is visualized in the usual location immediately adjacent to the vesico-ureteral junction.

C. Cinecystogram, after complete emptying of the bladder. No bladder residue, but obvious ureteral residue. The frames immediately preceding showed the mucosal saccule and the "extra-vesical ureter obstruction phenomenon," the so-called "notch."

neck and internal sphincter region of the urethra, it was filled on only a single frame during the voiding urethrogram. This patient showed dilatation of the lower third of the ureter on the excretory urogram, and reflux into the ureter was identified on the cine study.

*Ureterectasis of the Lower Third of the Ureter:* Figure 7, A demonstrates ureter-

ectasis of the lower third of the ureter in a four-year-old male, arousing suspicion of vesico-ureteral reflux (6). This sign, a dilated lower third of the ureter with narrowing and constriction at the ureterovesical junction in the presence of infection, is thought to be a definite indication for cystourethrography, with a search for possible reflux (7). In this case func-



Fig. 6. Bladder outlet abnormality. Cinecystography during voiding (strip of 3 frames in succession) in a three - and - a - half - year - old girl with enuresis and frequency. The first frame shows an eccentric base of the bladder on the right, suggesting a mass slightly elevating the floor. The second reveals this to be a urethral cyst or diverticulum transiently filled on one frame only. The third frame again shows the same appearance as the first. The entire sequence was made in less than one-half second, emphasizing the need of constant surveillance during voiding.

tion was shown to be delayed on the right on the excretory urogram, and retrograde filling identified the "hypoplastic kidney outline" (Fig. 7, B). Attention is drawn to the lack of bladder residual, with marked bilateral ureterectasis on the cinecystogram (Fig. 7, D), in contrast to the assumed residual on the excretory post-voiding film (Fig. 7, A). Relative resistance at the outlet of the bladder was greater than at the vesico-ureteral junction and urination up the ureter rather than down the urethra (20) was preferred. Voiding cystography had been performed by conventional methods some three years preceding the present examination, and no reflux was identified at that time. The child was subjected to the present examination primarily because of the appearance on the excretory urogram of a dilated lower third of the ureter (Fig. 7, A). This has proved to be a most valuable clue, warranting further study of the type described here and yielding a high incidence of vesico-ureteral reflux when seen on the excretory urogram. There has been no single case of achalasia in the presence of this finding, for in all such patients peristalsis has been shown on cineradiographic studies (Figs. 7, C and D).

*Periureteral Vesical Mucosal Hernia:* Figure 7, A serves well to demonstrate perhaps the most positive indication of probable vesico-ureteral reflux seen on the excretory urogram. This is the small medium-containing protrusion beyond the bladder shadow, immediately adjacent to the vesico-ureteral junction. The explanation of Hutch (17) adequately describes the anatomic changes occurring in this region, due to the displacement of the former intravesical ureter to an extravescical position. This originally intravesical portion of the ureter, incapable of propelling urine, serves as an obstructing segment and explains the narrowing mentioned in the preceding section, "Ureterectasis of the Lower Third of the Ureter," and illustrated in Figures 2, B and C, 7, A, 10, A and B, 11, and 13, B. Breakdown of the longitudinal muscle fibers

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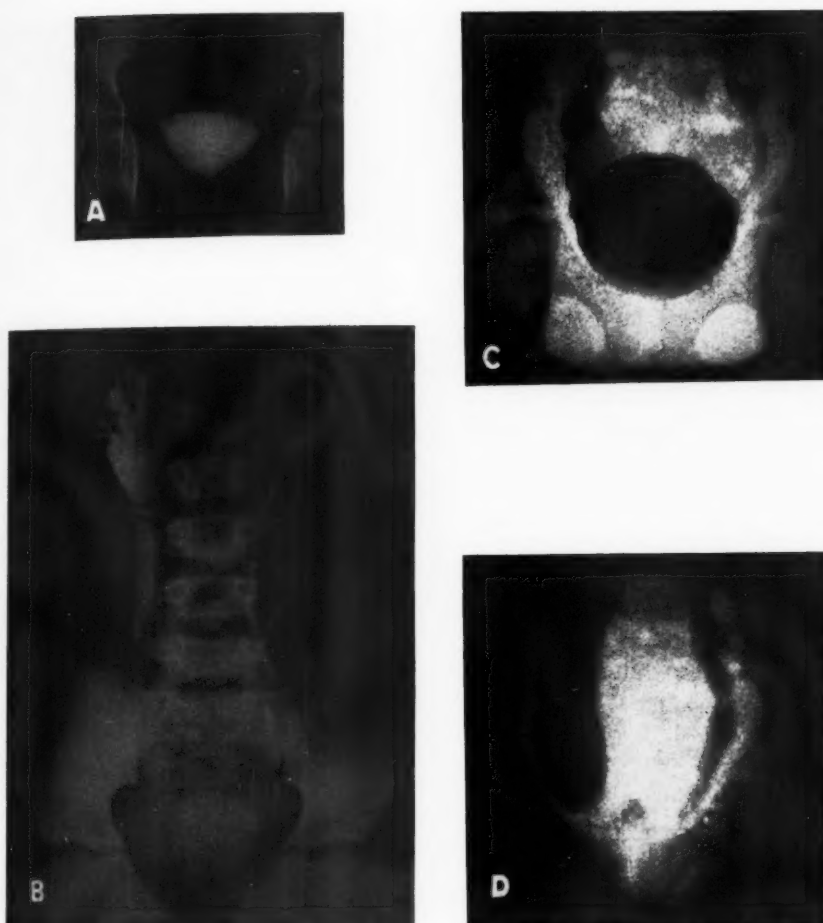


Fig. 7. Dilatation of the lower third of the ureter in a four-year-old boy with a three-year history of repeated episodes of a septic type of fever with urinary infection.

A. Excretory urogram, post-voiding film. Small mucosal saccule in the usual location next to the dilated left ureter.

B. Retrograde pyelogram: Hypoplastic contour of the right kidney, bilateral ureterectasis, and the suggestion of some ureteropelvic obstruction.

C. Cinecystogram after one-hour delay. Note marked bilateral reflux with both hyperbaric and hypobaric Lipiodol reaching the kidney. No reflux occurred with initial bladder filling or upon the one-half-hour delay.

D. Cinecystogram, at completion of voiding: No significant bladder residue, but increased ureteral residue. The bladder residue, measured by means of a catheter following this film, was 2.25 ounces, obviously from the ureters. This study emphasizes the lack of outlet obstruction or at least a lesser resistance to intravesical pressure at the vesico-ureteral junction than at the urethrovaginal junction.

(Waldeyer's sheath) also occurs and, because the ureter is no longer pulled together by muscle activity, the defect thus created allows bladder mucosal herniation. Note the apparent space between the dome of the hernia saccule and the terminal end of the ureter. When present, either

the "notch sign" or the "mucosal hernia," or both, are virtually pathognomonic of vesico-ureteral reflux. Thus, in the face of an actually incomplete "valve mechanism," an appearance of urethral obstruction is present (Figs. 2, B and C; 7, D; 10, A and B; 11; 13, B). A "ves-





Fig. 8. Bladder mucosal sacculum at surgery. The right ureterovesical junction visualized with a ureteral catheter passing from the interior of the bladder into the ureter. Immediately adjacent to it is the "dimple" or defect in the musculature of the bladder that allows the mucosa in this area to herniate and produce the roentgen appearance of a sacculum. (Surgical photograph, courtesy of Dr. Robert Osborne.)

ical mucosal hernia" directly visualized at the time of surgery is demonstrated in Figure 8. That this is not a phenomenon limited to children is emphasized and illustrated by Figures 5, B and 9. These are roentgenograms of 2 adults who complained of pain radiating from the bladder region around the flank to the kidney, the reverse of pain radiation from the usual renal colic.

The "weak-wall appearance" is observed in a high percentage of patients if they are carefully and constantly observed during voiding (Fig. 12). The bladder-wall muscle alteration is also evidenced in Figure 6 on the right, with reflux on the left.

*Renal Parenchymal Destruction Due to Vesico-Ureteral Reflux:* The eventual result of known and observed persistent reflux is illustrated by the case shown in Figures 13, A and B. In this patient, a boy of twelve, vesico-ureteral reflux was discovered some seven years earlier by conventional voiding cystograms. At that time the excretory urogram was almost normal. The case was then considered an outlet problem but, though the outlet

obstruction was corrected, the reflux obviously was not. Again, there is no significant residual in this patient's bladder at the time of voiding. Nevertheless, there has been increasing renal parenchymal destruction over the seven years.

#### DISCUSSION

It has been repeatedly emphasized that in many cases of vesico-ureteral reflux

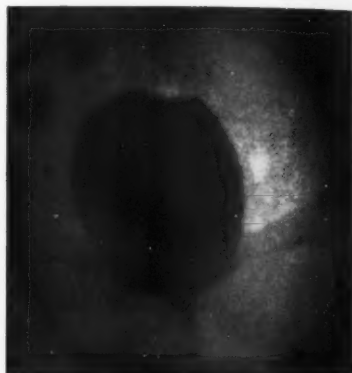


Fig. 9. Mucosal sacculum. Cinecystogram, early voiding, in a woman thirty-one years old, with three children. There was a five-year history of back pain, with intermittent, but persistent, urinary infection.

An excretory urogram appeared entirely normal on one occasion. On a second study, there was suggested dilatation of the lower third of the right ureter and a sacculum. The voiding cinecystogram demonstrates an obvious, relatively large, mucosal sacculum on the right and early ureteral reflux on the left. The ureters are implanted low in the bladder floor. Eventually bilateral reflux occurred.

the excretory urogram is within normal limits. This, indeed, is true. Certain clues demonstrable on the excretory urogram, however, suggest the possibility of reflux and are felt to be sufficiently reliable to warrant serious consideration when coincidental with a proper history and physical findings. In the order of importance, they are: (a) minimal dilatation of the lower third of the ureter with ureterovesical "narrowing"; (b) the presence of the "bladder mucosal sacculum" in both the trabeculated and non-trabeculated bladder; (c) the presence of the "notch sign" on the excretory urogram;

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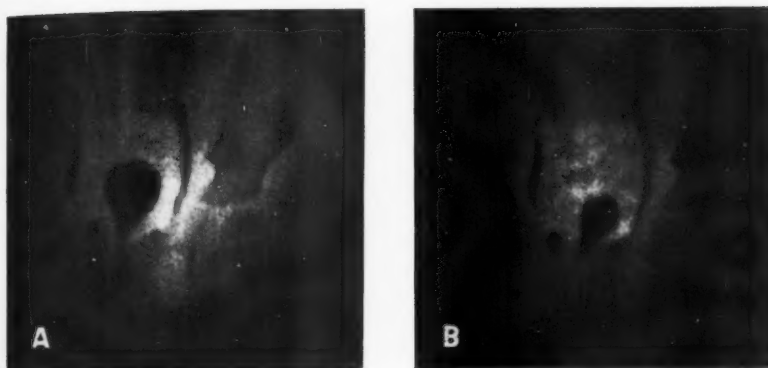


Fig. 10. Posterior urethral obstruction suspected in a boy two and a half years old because of measured bladder residue.

A. Cinecystogram, voiding. Bilateral reflux to kidney pelves. Note bilateral saccule and notch, as well as dilated posterior urethra, suggesting obstruction.

B. Cinecystogram, voiding, later stage. Notch and saccule persist, but posterior urethral dilatation has disappeared, thus disproving organic origin. Compare with Figure 4, in which the urethral defect persisted.

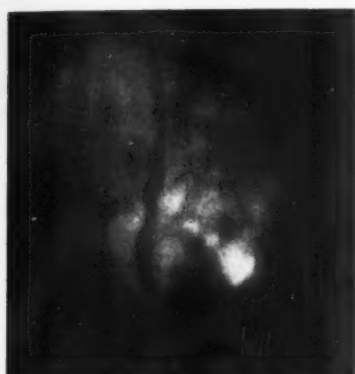


Fig. 11. Cinecystogram, end of voiding, in six-year-old male with intermittent, chronic urinary tract infections for three years. Reflux not seen on conventional study. Excretory urogram revealed dilated lower third of right ureter. Conventional voiding cystography failed to show reflux. Six months later voiding cinecystography demonstrated right reflux with notch.

This case could be used as an example of the superiority of cinecystography as a means for detecting reflux. However, the fact that reflux may, for some unknown reason, be demonstrated on one occasion and not on another, *should* emphasize the need for multiple examinations in those cases where reflux is strongly suspected. Successive cinecystograms in other cases have revealed this same phenomenon.

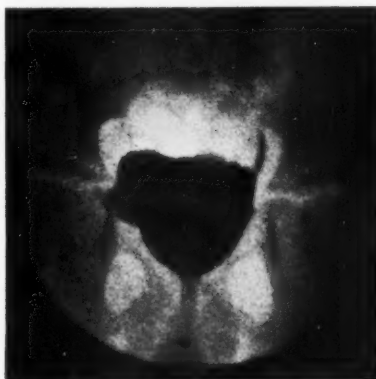


Fig. 12. "Weak bladder wall." Cinecystogram, early voiding, in eight-year-old female, with vague, left, lower abdominal pain. The "weak wall" appearance on the right, mucosal saccule, and the reflux on the left must be searched for constantly as they are many times transient. Later in the study, there was also reflux on the right.

strable small or suspected hypoplastic kidney; (f) malposition of the urethral orifice, duplication of ureter, or ectopic kidney. In the presence of any of these findings, cinecystography and voiding urethrography are indicated.

Voiding cinecystography is superior to the conventional study since it allows a more accurate evaluation as to the time of vesico-ureteral reflux and thus may assist considerably in the choice of therapy.

(d) the presence of ureteropelvic obstruction or otherwise unexplained caliectasis, pyelectasis, or ureterectasis; (e) demon-

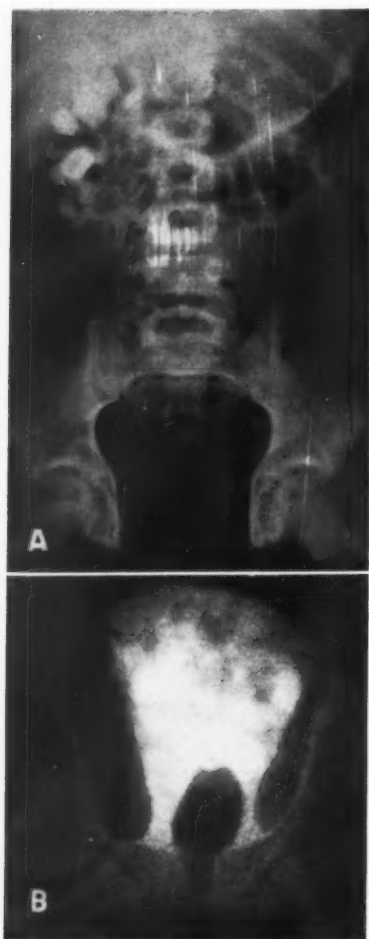


Fig. 13. Bilateral hydronephrosis in a boy twelve years old with a seven-year history of persistent intermittent infected urine. Excretory urogram seven years before showed little or no indication of hydronephrosis or other abnormality. Bladder "outlet obstruction" had been corrected surgically six years earlier.

A. Excretory urogram, supine, fifteen-minute film. Bilateral hydronephrosis.

B. Cinecystogram, near completion of voiding. Bilateral marked vesicoureteral reflux and bilateral notch. Note the hyperbaric Lipiodol in the right ureter just proximal to the notch. The hypobaric Lipiodol and water-soluble medium reached the renal pelvis and calyces. The large funnel-shaped vesical outlet is secondary to the surgical correction six years earlier. Thus, there is no significant vesical residuum at this time.

Medical management is quite satisfactory if marked bladder distention is required for reflux to occur, or if it is seen only

upon delay with a distended bladder. If an organic urethral obstruction is demonstrable, surgical attack upon this region will be required for permanent correction. Filling, delayed, and voiding cinecystography provides information that is not obtained by any other method, differentiating between anatomic abnormality and physiologic misbehavior. It permits the distinction between achalasia of the ureter and localized ureterectasis due to vesico-ureteral reflux. It assists in distinguishing true organic defects of the urethra from localized areas of muscle spasm that produce defects in the urethra suggesting valves on solitary conventional films. The procedure aids, also, in the evaluation of vesico-urethral outlet physiology during normal and abnormal micturition.

#### SUMMARY

The potentialities and advantages of the cineradiographic method in evaluating the lower urinary tract in the course of filling, delay, and voiding are presented.

Vesico-ureteral reflux is discussed and its serious significance is emphasized.

The ability of the cinefluorographic method to detect a greater number of vesico-ureteral reflux cases, as well as its contribution in distinguishing between organic and functional deformities of the urethra, is emphasized.

Certain "clues" to suspected vesico-ureteral reflux on excretory urography or retrograde examination of the urinary tract are presented. It is suggested that individuals with such findings be subjected to further cinecystography for detection of vesico-ureteral reflux.

NOTE: The authors thank John A. Hutch, M.D., for his interest and assistance in this project.

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## SUMMARIO IN INTERLINGUA

## Cineurethrographia e Cinecystographia in Vacuation, con Attention Special Prestate al Refluxo Vesico-Ureteral

Le objectivo del presente communication es triplice: Primo, monstrar le potentialitates del methodo cinefluorographic pro le evaluation de morbo del vias urinari inferior in juveniles e adultos; secundo, revistar le refluxo vesico-ureteral como un entitate clinic per le presentation de casos e illustrar assi le advantages del cinemethodo in iste studio; e tertio, presentar certe indicios de refluxo vesico-ureteral a base de observationes del urogramma excretori o de studios retrograde.

Indicios demonstrabile in le urogramma sufficientemente stabile pro justificar un alte grado de suspicion quando illos es presente in coincidentia con appropriate datos anamnestic e constataiones physic es (a) un grado minime de dilatation del tertio inferior del ureter, con restringimento uretero-vesical, (b) le presentia del "sacculo mucosal del vesica" tanto in le vesica trabeculate como etiam in le vesica non-trabeculate, (c) le signo de "indentation" in le urogramma excretori, (d) ob-

struction ureteropelvic o alteremente inexplicate calicectasis, pyelectasis, o ureterectasis, (e) demonstrabilitate de un micre ren o suspicion de hypoplasia renal, e (f) malposition del orificio urethral, duplication del ureter, o ectopia renal. In le presentia del un o del altere de iste constataiones, cinecystographia e urethrographia excretori es indicate.

Cinecystographia excretori es superior al forma conventional del studio. Illo permette un plus accurate evaluation con respecto al tempore del refluxo vesico-ureteral e assiste assi in le selection del therapia. Si un organice obstruction urethral es demonstrabile, chirurgia es requirite. Cinecystographia replenatori, retardate, e excretori provide information que non es obtenibile per ulle altere methodo in le differentiation inter anormalitate anatomic e dysfunction physiologic. Illo assiste in le evaluation del physiologia del egresso vesico-urethral in micturition normal e anormal.

# A Report on the Use of Grids for Fluoroscopy

## Image Intensifiers and Cineradiography<sup>1</sup>

FRANK W. DREISINGER, R.T.,<sup>2</sup> and GOFFREDO G. GENSINI, M.D.<sup>3</sup>

UP TO THE PAST few years, it was a relatively easy task to select a stationary grid. If it was intended for radiography, the one with the finest pattern and best "clean-up" was chosen. These qualities were frequently determined by obtaining a roentgenogram of a thick and high-density area of the body (*e.g.*, a lateral view of the lumbar spine).

Before rotating anode tubes came into common use for spot-filming, many radiologists had to be content with small-field "non-grid" spots. This was necessary because of the limited loading factors for stationary anode tubes and the long exposure times required with grids. When high-capacity rotating anode tubes became available, many radiologists began to employ stationary grids for fluoroscopy and spot-filming.

Today several manufacturers make radial, parallel, and crisscross grids in at least seven ratios, with metal, pith, or plastic interspace material. The purpose of the study to be reported here was the evaluation of six commercially available grids suitable for use with the under-table fluoroscopic x-ray tube and of two new experimental grids. Because of high absorption, grids with ratios greater than 8:1 were not studied.

The choice of a grid for any roentgen application is governed by: (a) the thickness and opacity of the part in question; (b) the size and/or volume of the field to be examined; (c) the kilovoltage to be used. A significant change in any one of the three factors will alter the requirements for the grid.

The shuttered-down field sizes for fluoroscopy rarely exceed  $8 \times 10$  inches.

Indeed, the overall size of the fluoroscopic screen in American apparatus is hardly ever larger than  $12 \times 12$  inches. It follows that the quantity of scattered radiation encountered is frequently less than that in conventional radiography, where patient areas as large as  $14 \times 17$  inches are commonplace.

For the tests, each grid was assigned a serial number from 1 to 8.

### GRIDS USED

	Ratio	Serial No.
1. Liebel Flarsheim		
(a) Fineline	6:1	2
(b) Microfine	8:1	4
(c) Experimental	$3 \frac{1}{2}$ :1	8
2. Lysholm Schönander		
(a) Standard	5:1	1
(b) 75 line	$6 \frac{1}{2}$ :1	5
(c) 75 line	8:1	6
3. Smit Roentgen		
(a) Experimental	$5 \frac{1}{2}$ :1	3
4. Siemens		
(a) Standard	7:1	7

### ABSORPTION RATINGS FOR FLUOROSCOPY AND IMAGE INTENSIFIERS<sup>4</sup>

For conventional fluoroscopy the Radelin FGP screen (1960 serial number 001901) was used. The arrangement of x-ray tube, phantom, and "light"-measuring equipment is shown in Figure 1. This relationship of apparatus was maintained throughout the tests, and several readings were made and averaged for each grid. The results of this procedure in order of increasing absorption are shown in Table I.

*Image Intensifiers:* Similar tests were run with the Picker 22-cm. intensifier image tube (gain 1,250) and the light-emission of the output phosphor was measured with each grid interposed. Re-

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<sup>4</sup> We are indebted to F. R. Hays, senior physicist of Radelin Division, U. S. Radium Corporation, for assistance with these tests.



sults show the same relationship charted above for the conventional screen. Many of the early intensifiers in use have gains of 500 and less. The substitution of a low-absorption grid for one with high absorption may mean the difference between

Cinefluor film and a 7-inch water phantom were used for all exposures. A series of test films was made at 80 and 100 kvp for each grid, the film densities were read on a Photovolt densitometer, and again the results corresponded to those in Table I.

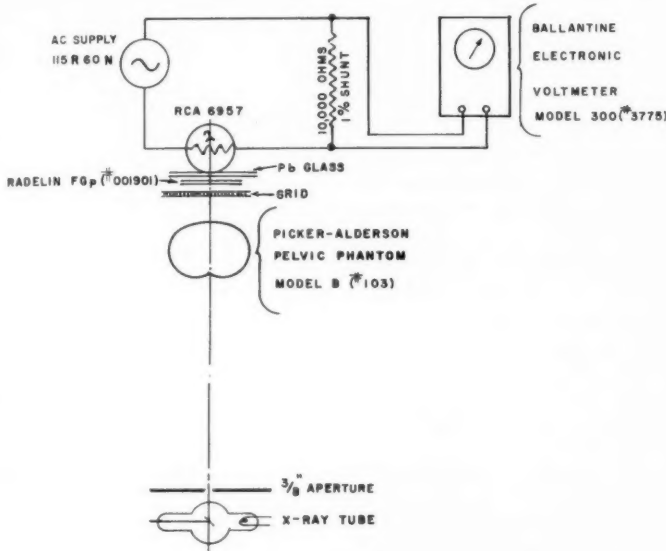


Fig. 1. Arrangement of x-ray tube, phantom, and light-measuring equipment.

TABLE I: READINGS FOR EIGHT DIFFERENT GRIDS

Serial No.	Grid	Ratio	*Light Emission	* Per Cent Transmission
8	Liebel Experimental	3 1/2:1	0.58	100
2	Liebel Fineline	6:1	0.49	84
3	Smit Experimental	5 1/2:1	0.44	76
1	Schönander Standard	5:1	0.38	65
7	Siemens Standard	7:1	0.36	62
5	Schönander 75 line	6 1/2:1	0.36	62
4	Liebel Microline	8:1	0.31	53
6	Schönander 75 line	8:1	0.29	48

\* These are arbitrary readings but do reflect a linear relationship. For example, if we assign a transmission factor of 100 per cent for the Liebel Experimental (which has the lowest absorption), then the per cent transmission of other grids will be as shown. This means that, if the Liebel 3 1/2:1 grid (No. 8) is substituted for either of the last two (grids No. 4 and No. 6), the fluoroscopic screen would be twice as bright, or the x-radiation level could be reduced to one-half for the same brightness. Spot-film exposure times would be doubled with the Liebel Microline grid (No. 4) as compared with the Liebel 3 1/2:1 grid (No. 8).

"cone" and "rod" vision for many examinations.

#### CINERADIOGRAPHY

For cineradiographic tests the Picker 22-cm. image tube, 16-mm. cine camera, and Dynapulse were employed. Exposure times per frame were preset over a range from 0.5 to 5.0 milliseconds. Kodak

#### RAPID SERIAL RADIOGRAPHY

Two series of chest films were made with a single-plane Schönander film changer. Three grids were used.

Grid	Ratio	Serial No.
(a) Liebel	3 1/2:1	8
(b) Schönander Standard	5:1	1
(c) Smit Experimental	5 1/2:1	3

For the first series, the factors were:

1.	Ma	Time	kvp	Distance	Patient
	400	$\frac{1}{60}$ sec.	115	36 in.	160 lb.

For the second series, kvp was varied with Dynapulse timing as follows:

2.	Ma	Time	kvp	Patient
(a)	1,000	$4\frac{1}{2}$ milliseconds	107 (Schönander) 102 (Smit) 97 (Liebel)	160 lb.
(b)	1,000	$3\frac{1}{2}$ milliseconds	107 (Schönander) 102 (Smit) 97 (Liebel)	

In the first series the Liebel grid produced the darker film, and the Schönander the lightest. In Series 2 (a) the Schönander grid at 107 kvp and 4.5 milliseconds compared favorably in density and contrast with the Liebel of Series 2 (b) at 97 kvp and 3.5 milliseconds.

Because the chest does not produce much scatter, the contrast was similar throughout.

#### RADIOGRAPHY

A 9-inch field was selected as representing the normal field sizes in conven-

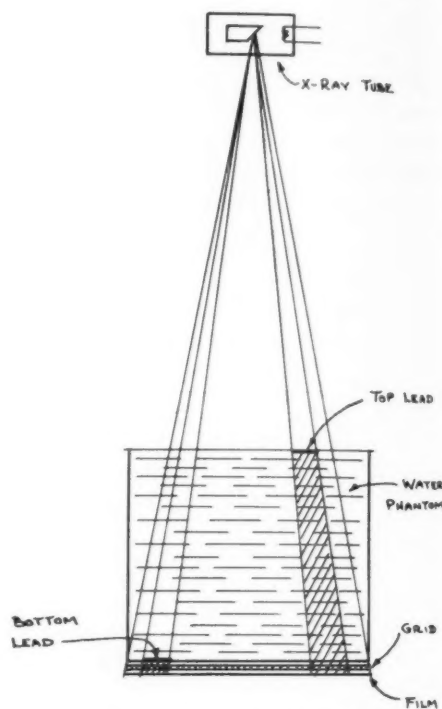


Fig. 2. Test arrangement employed for small-field radiography.

TABLE II: DENSITIES OBTAINED WITH EIGHT DIFFERENT GRIDS\*

Serial No.		Col. 1. Bottom Lead	Col. 2. Top Lead	Col. 3. Back-ground	Col. 4. Image-Producing Radiation	Col. 5. Exposure Increase (%)
8	*Liebel (3 $\frac{1}{2}$ :1)	0.20	0.34 (0.14)	1.25	1.11	...
2	Liebel Finline (6:1)	0.19	0.28 (0.09)	1.00	0.91	+25
3	†Smit (5 $\frac{1}{2}$ :1)	0.19	0.27 (0.08)	0.96	0.88	+31
1	Schönander (5:1)	0.19	0.28 (0.09)	0.94	0.85	+35
7	Siemens (7:1)	0.20	0.26 (0.06)	0.91	0.85	+37
5	Schönander "75" (6 $\frac{1}{2}$ :1)	0.20	0.26 (0.06)	0.89	0.83	+41
4	Liebel Microline (8:1)	0.18	0.21 (0.03)	0.78	0.75	+58
6	Schönander "75" (8:1)	0.19	0.23 (0.04)	0.62	0.58	+85

\* Col. 1. Base + fog. Col. 2. Scatter density. Col. 3. Total density. Col. 4. Background (top lead-bottom lead).

† Grid is now commercially available.

tional and intensified fluoroscopy as well as spot-filming. A first series of antero-posterior and lateral sacral films were made at 100 kvp with the Picker-Alderson pelvic phantom. The filters at the tube port were 0.25 mm. Cu and 0.5 mm. Al.

A second series of films was made with a 10-inch-thick water phantom. On top of the water a piece of 1/8-inch sheet lead

was suspended, and on the film a second piece of sheet lead of the same thickness was placed. Exposure was selected to yield film densities between 0.5 and 1.5. Table II shows the results in this series. The grids are listed in order of absorption, from low to high. A speed factor of 1.00 was assigned to the grid with the lowest absorption. The log exposure values for

all other grid densities were then plotted on the characteristic curves for Kodak Blue Brand film, to determine exposure increases necessary for the other grids.

A close look at the various columns will disclose the key factors in the selection of a grid for fluoroscopy and fluorofilming. For example, Column 1 shows that for all exposures under the bottom lead, the film received substantially no radiation. So these densities represent base + fog readings for the Blue Brand film-Pix developer combination used.

Column 2 shows the film densities under the top lead. If the base + fog density figures of Column 1 are subtracted from these figures, the bracketed numbers are the result of scattered radiation from the phantom. Here the Liebel Microline 8:1 demonstrates the most effective "clean-up" and the Liebel 3 1/2:1 the least effective. It is interesting that for this test the difference between the two extremes is quite small.

Column 3 gives the density figures which represent all the radiation that reached the film—primary + scatter and, of course, the contribution of base + fog. Here the difference in transmission between low and high is most significant.

Column 4 gives the results when scatter density (Column 2) is subtracted from background density (Column 3). These Column 4 figures supply the key to the image-producing radiation, or the absorption of primary radiation by the grid.

Column 5 points out the per cent increase in radiation exposure necessary to equal the image-producing density of the Liebel 3 1/2:1.

There can be no doubt that the high-absorbing grids yield the most effective "clean-up." However, for the relatively small field employed with fluoroscopy and fluorofilming, it is felt that the penalty in patient radiation is too great to justify the slight improvement in image quality.

#### SUMMARY

Eight stationary grids were tested for absorption in conventional fluoroscopy, intensified fluoroscopy, cineradiography, rapid serial radiography, and small-field radiography.

Some interesting conclusions are drawn from this study. For the grids studied:

1. "Clean-up" is greater for the grids with higher ratio. The best compromise for inclusion of "clean-up" and low absorption is the Smit 5 1/2:1 grid.

2. The lowest absorbing grid is the Liebel experimental. Its use will result in the shortest possible exposure times for spot-filming, rapid serial radiography, and cineradiography.

3. The fluoroscopic screen and/or the image intensifier will be significantly brighter for the low-absorption grids.

4. For the 5-inch intensifier and small-field fluoroscopy, many radiologists may prefer nongrid technics.

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#### SUMMARIO IN INTERLINGUA

##### Un Reporto in Re le Uso de Grillias in le Fluoroscopia: Intensificatores de Imagine e Cineradiographia

Octo grillias stationari esseva testate pro lor absorption in fluoroscopia conventional, in fluoroscopia intensificate, in cineradiographia, in rapide radiographia serial, e in radiographia a micre campos. Le grillias esseva Fine line, Microline, e Experimental de Liebel-Fleischheim con proportiones (respectivamente) de 6:1, 8:1, e 3 1/2:1; Standard e duo typos a 75 lineas con pro-

portiones (respectivamente) de 5:1, 6 1/2:1, e 8:1; Experimental de Smit con un proportion de 5 1/2:1; e Standard de Seemens con un proportion de 7:1. In le uso de iste grillias le sequente constata-tiones esseva facite:

1. Le nitidification es plus marcate in le caso del grillias con plus alte propor-tiones. Le melior compromisso inter le

desideratos de nitidification e basse absorption es providite per le grillia de Smit.

2. Le plus basse absorption es illo del grillia Experimental de Liebel. Su uso resulta in le tempores de exposition le plus curtes possibile in radiographia a micre campos, rapide radiographia serial, e cine-radiographia.

3. Le ecran fluoroscopic e/o le intensificator de imagine se face significative-mente plus brillante pro le grillias a basse absorption.

4. Pro le intensificator de cinque pollices e in fluoroscopia a micre campos, il es ben possibile que multe radiologos prefere technicas sin le uso de grillias.



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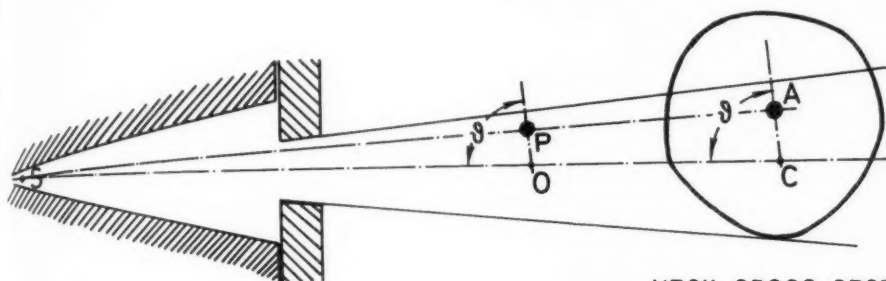
# Synchronous Protection and Field Shaping in Cyclotherapy<sup>1</sup>

BASIL S. PROIMOS

IN A PAPER appearing in RADIOLOGY for May 1960, on "Synchronous Field Shaping in Rotational Megavolt Therapy," two geometric technics for improving dose distribution in the patient were suggested. It is our object, in this second contribution, to examine the same subject more quantitatively and to discuss the influence of some geometric factors on the distribution of ionization.

Suppose that P and A are rotating with the same angular velocity about O and C, respectively, and that PO was parallel to AC initially. Then the cord, A, will remain under the x-ray shadow of the protector, P, for any value of the angle  $\theta$  of rotation.

This technic was applied to a Masonite cylinder 20 cm. in diameter, with the field wide enough to cover the whole



NECK CROSS SECTION

Fig. 1. The cross sections of the spinal cord, A, and of the protector, P, rotate synchronously about the centers C and O, respectively.

All the isodose curves shown below were determined in the following manner: A horizontal x-ray beam, produced by a 2-Mev Van de Graaff generator, was directed toward a Masonite phantom standing on a therapy table and rotating about a vertical axis 125 cm. from the source. The distribution of ionization was recorded on x-ray film sandwiched in transverse cross sections of the phantom.

## SYNCHRONOUS PROTECTION

With the synchronous protection technic, the irradiation of a sensitive organ can be reduced while some or all of the surrounding tissue is treated. The application of this procedure to protection of the spinal cord is illustrated in Figure 1. The patient rotates around a vertical axis which meets the neck cross section at C. The absorber, P, protects the cord, A, against the radiation emitted by source S.

width of the cylinder at all times. A small selsyn-driver was driven mechanically by the rotating table and was electrically connected to a similar selsyn-follower, which in turn rotated the protector, P. In this way, the protector P rotated in synchronism with the phantom. The protectors and distances employed are indicated in Figure 2.

The value of the protection in each case is shown by the depth of the upside-down bell formed if the corresponding curve of Figure 2 is rotated about the vertical axis. For the curve C of maximum protection, a non-moving vertical lead bar, of  $1.2 \times 6$  cm. cross section, was placed at the vertical central plane of the beam, with the 6 cm. dimension parallel to the beam. Thus, a cylinder of protection, 2 cm. in diameter, was formed around the axis of rotation of the Masonite cylinder. Since the transmission of direct radiation through 6 cm. of lead is negligible, all the

<sup>1</sup> Accepted for publication in March 1961.



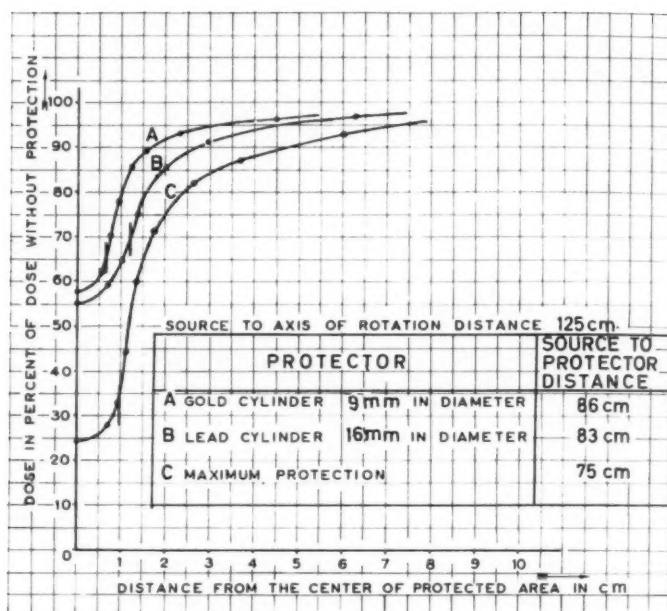


Fig. 2. Distribution of dosage in and around the protected region.

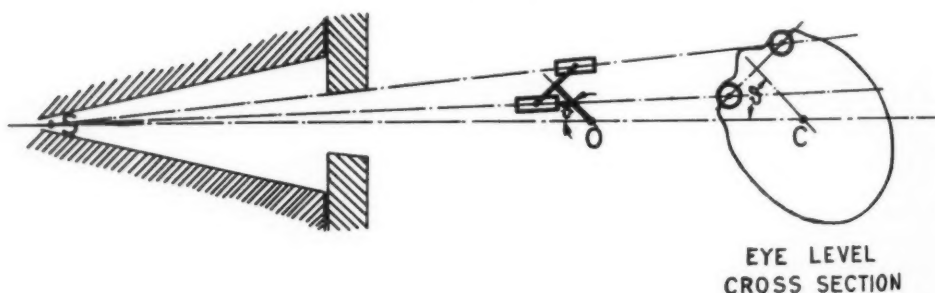


Fig. 3. Synchronous protection of both eyes.

dosage in the protected region is due to scattered radiation. Usually, in practice, the width of a rotational field is much smaller than 20 cm. This reduces the scattered radiation, with corresponding improvement of the protection. The curves A, B, and C correspond to the unfavorable combination of wide field and small diameter protector.

In a similar way, one or both of the eyes can be protected, as shown in Figure 3. The protection of each eye is assigned to one cylinder, which must rotate in synchronism with the corresponding eye. In addition, it must be oriented to remain

parallel to the direction of the rays. If spheres are used for the eye protection, the necessity of the last orientation does not exist and the mechanism is simpler. The disadvantage of a sphere, however, is that an appreciable fraction of direct radiation will be transmitted through it, even if it is made of platinum. An arrangement such as that of Figure 3 gave the distribution shown in Figure 4. Two gold cylinders, about 1/2 inch in diameter and 1 inch long, were used for the protection. The numbers on the isodose curves show the dose in per cent of the air dose at the axis of rotation.

The same idea of rotational protection can be used if the radiation source is rotating about an immobilized patient. At all positions, the protector must keep the source in "total eclipse" with respect to the non-moving sensitive organ. This can be done, without any "selsyns," by the very simple arrangement shown in Figure 5. The holder, AB, can rotate

distance, compared with the supervoltage x-ray machines. Both of the above geometric factors increase the penumbra and reduce the effect of protection.

#### SYNCHRONOUS FIELD SHAPING

The protected area, A, in Figure 1 will be changed to the only full-dose region of the cross section, if the protector

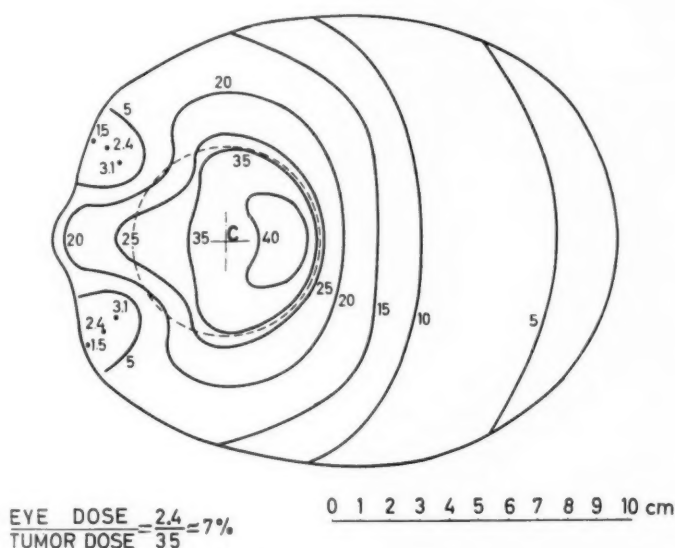


Fig. 4. Distribution of ionization corresponding to the arrangement of Figure 3.

freely about a horizontal small shaft whose axis, AO, lies on the plane defined by the source, S, and its axis of rotation, CC. During the rotation, the force of gravity alone is adequate to keep the holder, AB, vertical. As a result, the spinal cord protector remains parallel to itself, automatically. The relative position of the important parts of this arrangement, for the four characteristic positions  $S_1$ ,  $S_2$ ,  $S_3$ , and  $S_4$ , of the source, are shown in Figure 5.

Also the application of the eye protection system, with the two oriented cylinders, is easier in the case of a rotating source. The difficulty with cobalt-60 bombs comes from the large source diameter and the small source-to-axis-of-rotation

P is replaced by a rotating x-ray window. This can be done by the technic shown in Figure 6. The two shaded disks rotate around  $O_1$  and  $O_2$  synchronously with the neck cross section which rotates around C. Only the shaded region of the cross section is irradiated at all times. This technic gives two new degrees of freedom in field shaping:

(a) The position of the center, B, of the treated area is independent of the position of the center, C, of rotation.

(b) The shaded, maximal dose region can be of practically any shape if the corresponding shape is used for the rotating disks, *i.e.*, the slight elongation of disks in Figure 6 gave a slightly elongated full dose region. Consequently, no matter what

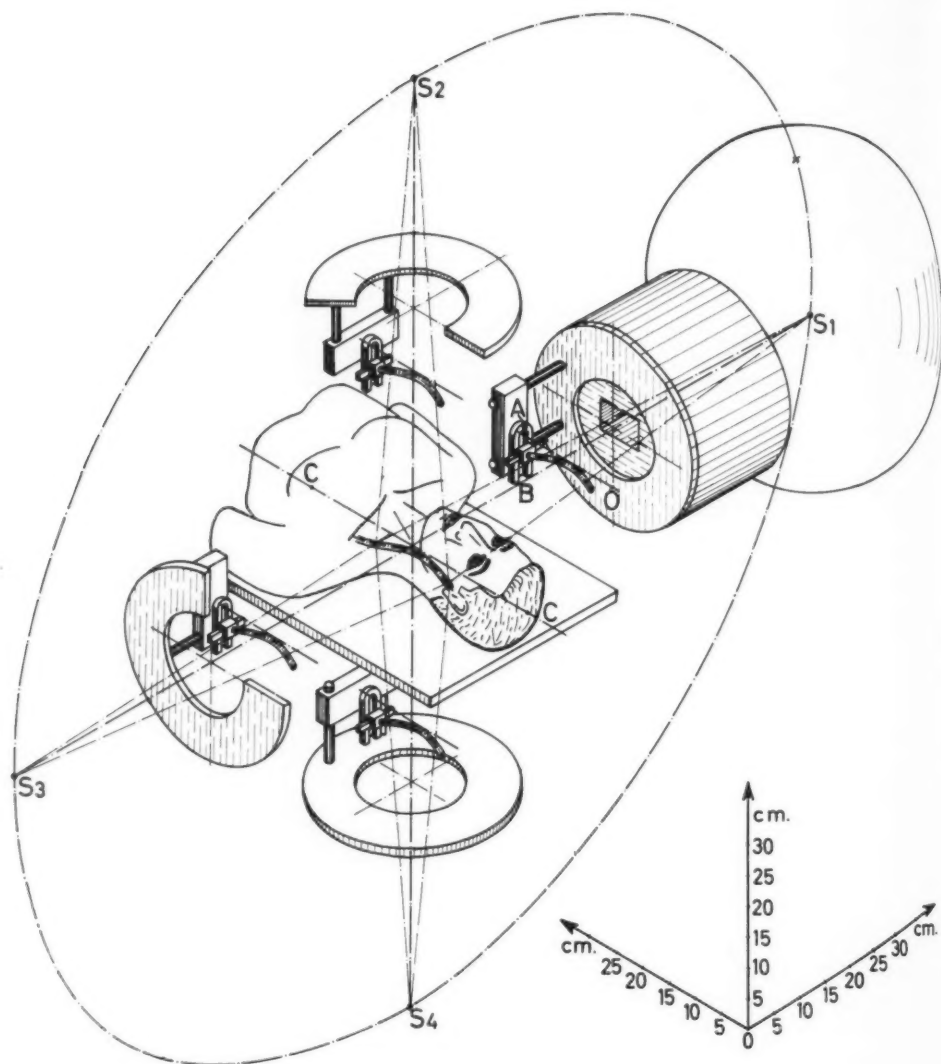


Fig. 5. Spinal cord protection in the case of a rotating source.

the three-dimensional shape of the tumor, the full dosage can be confined to it.

In ordinary rotational therapy the maximum dose region has to be circular and its center, B, cannot be displaced from the center of rotation, C. As a result, the full dose volume will be defined by a right cylinder of circular cross section. This cylinder will include a considerable amount of healthy tissue if the shape of the tumor is irregular. Besides, the healthy

tissue around this imaginary cylinder will receive a higher dose. In such a case the application of stationary (non-rotational) fields may be preferred.

The arrangement shown in Figure 6 gave the result presented in Figure 7. The spinal cord, A, has received about half the amount of radiation that would have been given to it without any protection.

The same technic applied in the pelvis

Fig. 7.

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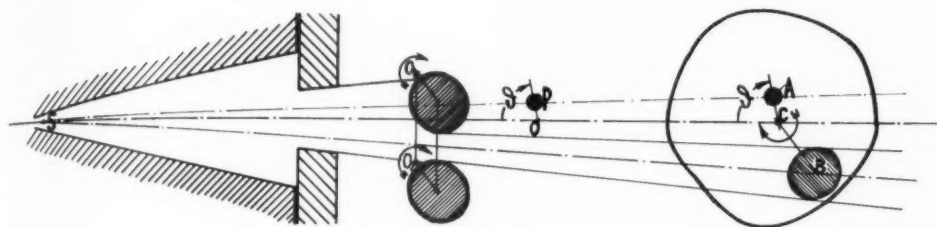


Fig. 6. Synchronous field shaping and synchronous protection.

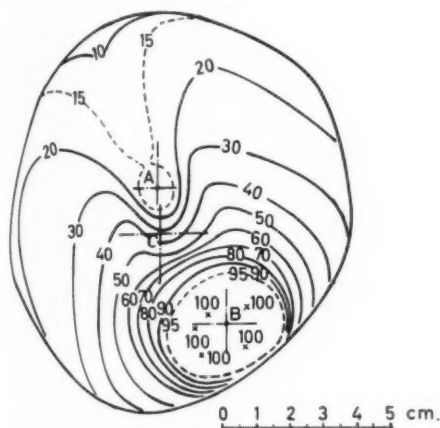


Fig. 7. Distribution of dosage obtained by the system shown in Figure 6.

region is shown in Figure 8. It was assumed that the region defined by the ellipse of center C was to be treated. Two cylindrical lead blocks of elliptical cross section were rotating about their centers,  $O_1$  and  $O_2$ , in synchronism with the rotation around C cross section. The large axis of the block cross section was 6.4 cm. and the small one was 2.5 cm. If ordinary rotational therapy was applied, the width of the beam would be fixed and equal to that shown in the "anterior position" in Figure 8. Then the full dose region, in Figure 9, would be a circle of diameter equal to the segment DE and the isodose curves outside of this circle would be spread in all directions as they are now along the line CB, i.e., the point A would receive about twice as much dosage.

#### GEOMETRIC ANALYSIS

The techniques described above introduced a new parameter, namely the position of

the center of rotation with respect to the center of the protected or treated region. In practice, it is important for calculations of dosage to know what is the influence of this position on the distribution of ionization. Can the available dosage nomograms, for the rotational therapy and curves, such as those of Figure 2, be used for any position of the center of rotation?

Suppose that the large solid-line circle of center O, in Figure 10, represents the patient cross section and that the small circle of center B defines the full dose region. The source may rotate around an immobilized patient or *vice versa*. Since the result is the same in both cases, it will be assumed that it is the source which rotates around the center C, describing the large dotted-line circle in Figure 10. The problem is to find if the position of C affects the dose at a given point, A, of the cross section.

The radiation beam meets the point A when the source travels along the arc  $S_1SS_2$  and the arc  $S_1'S'S_2'$ . The positions S and S' mark the middle points of these arcs. The dose delivered to the point A depends on the following factors:

(a) The absorption and scattering of radiation: The points O, B, and A are fixed and so are the lines  $S_1S_1'$  and  $S_2S_2'$ . Therefore, for any position of C the beam has to go through the same amount of tissue. As a result, absorption and scattering are independent of the position of C.

(b) The distance of A from the source S, according to the inverse-square law. Suppose that C moves to a new position C'. This translation can be analyzed to the two components CE and EC'.

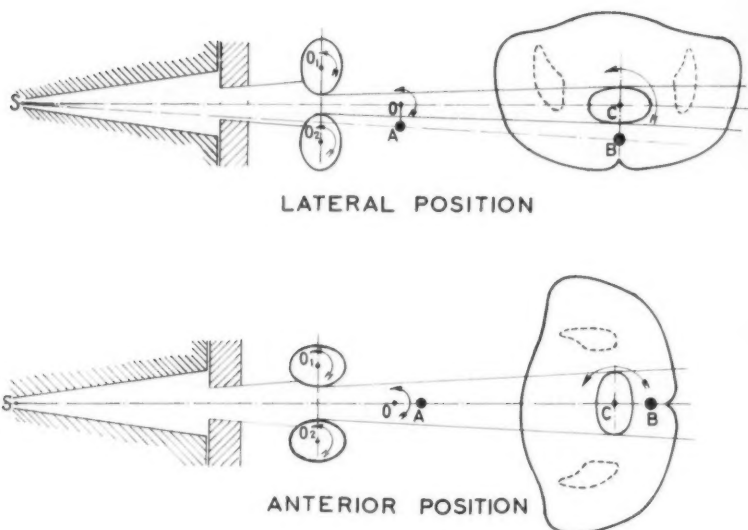


Fig. 8. Treatment of an elliptical area in the pelvic cavity.

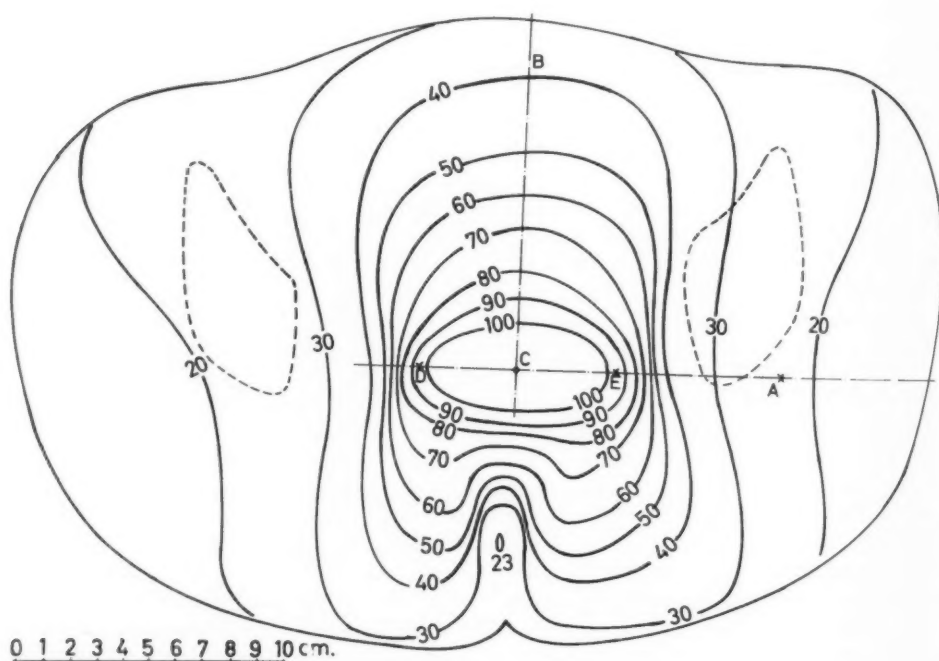


Fig. 9. Distribution of ionization obtained by the arrangement of Figure 8.

The translation  $CE$  being parallel to the line  $SS'$  will increase the distance  $SA$  by a length equal to  $EC$  and will decrease the distance  $S'A$  by an equal amount. There-

fore the average distance of  $A$  from  $S$  and  $S'$  remains the same. This fact and the fact that in reality  $CE$  is very small compared with  $SA$  indicate that the

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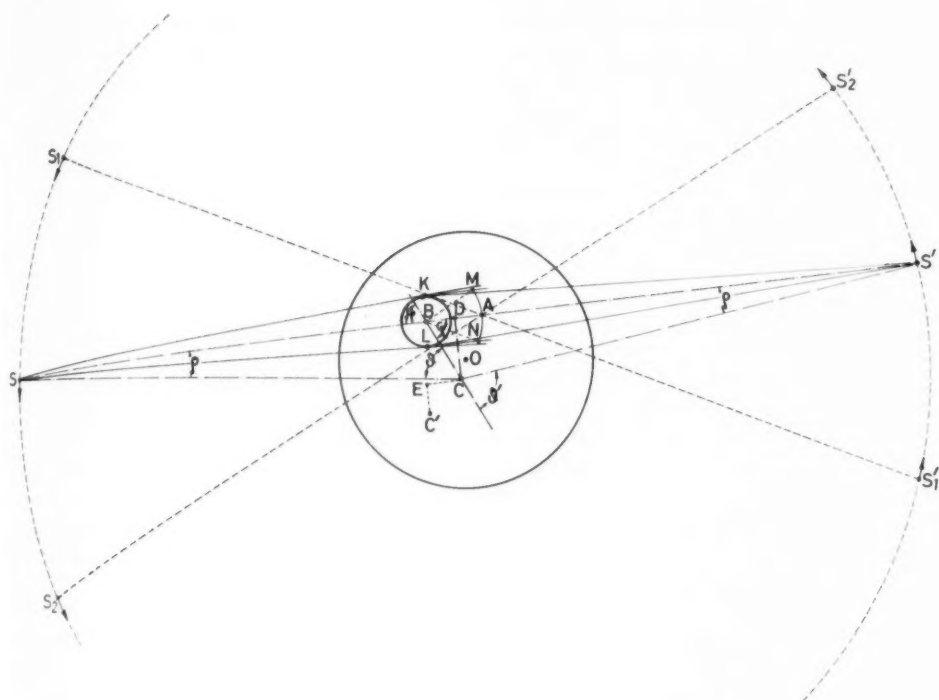


Fig. 10. Relation of dose at A to the position of the center of rotation, C.

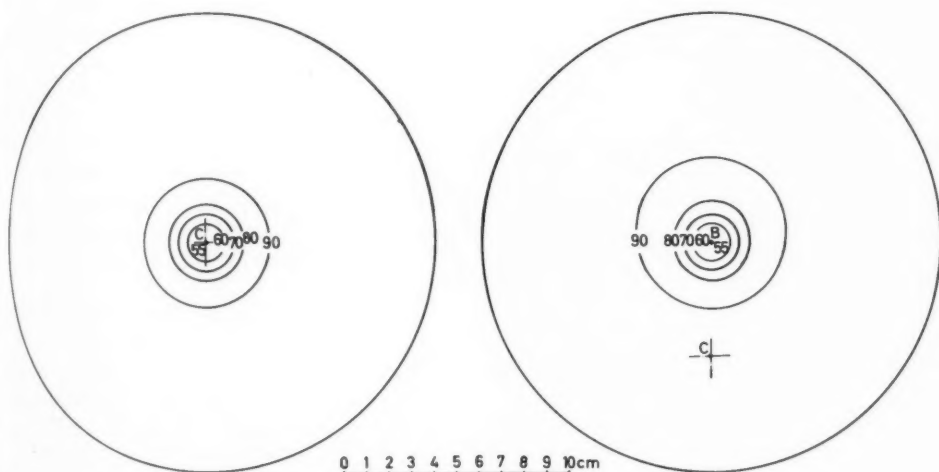


Fig. 11. Synchronous protection with the center of rotation at two different positions.

influence of the translation CE to the dose at A is negligible. The same holds for the small translation EC' mainly because it is normal to the line SS'.

(c) The time that A is in the beam during a full rotation of the source.

From the triangle SBC is derived that:

$$\varphi = \theta + \rho \quad (1)$$

The differentiation of the Equation (1) gives:

$$\frac{d\varphi}{dt} = \frac{d\theta}{dt} + \frac{d\rho}{dt} \quad (2)$$

But  $d\theta/dt$  is the angular velocity  $\omega$  of the rotation of the source around C and  $d\varphi/dt$  is the angular velocity  $\omega_1$  with which the line SB rotates around B.

For the small angle  $\rho$  it is:

$$\rho = \frac{DC}{CS} = \frac{BC \cdot \sin \varphi}{CS}$$

and

$$\frac{d\rho}{dt} = \frac{BC}{CS} \cos \varphi \frac{d\varphi}{dt}$$

or

$$\frac{d\rho}{dt} = \frac{BC}{CS} \omega_1 \cos \varphi.$$

Substitution in Equation (2) gives:

$$\omega_1 = \omega + \frac{BC}{CS} \omega_1 \cos \varphi$$

or

$$\omega_1 = \frac{\omega}{1 - (BC/CS) \cos \varphi} \quad (3)$$

In the same way, starting from the triangle BCS' ( $\varphi' = \varphi + \rho$ ) it is found that

$$\omega_1' = \frac{\omega}{1 + (BC/CS') \cos \varphi} \quad (4)$$

where  $\omega_1'$  is the angular velocity of BS' around B.

When the source describes the arc  $S_1SS_2$ , the central line of the beam covers an angle slightly larger than the angle MBN. But during the description of the arc  $S_1'S'S_2'$  the central line covers an angle slightly smaller than the angle MBN. The average of these two angles covered by the central line is equal to MBN and the total time elapsed is:

$$t = \frac{MBN}{\omega_1} + \frac{MBN}{\omega_1'} \quad (5)$$

By substitution from (3) and (4) into (5), and because  $CS = CS'$ , one finds:

$$t = \frac{MBN}{\omega} \left( 1 - \frac{BC}{CS} \cos \varphi + 1 + \frac{BC}{CS} \cos \varphi \right) \quad \text{or} \quad t = 2 \frac{MBN}{\omega} \quad (6)$$

The above expression (6) for the time that A stays in the beam during a complete rotation of the source does not include any magnitude connected with the position of the center of rotation C. Thus, within the approximations made in the above derivation, this time is independent of the position of the center C.

In exactly the same way it can be proved that, if the small circle of center B represents the *protected* area, the dose at the point A is practically independent of the position of the center of rotation C.

The result of the above analysis was experimentally tested. Synchronous protection was applied twice on a Masonite cylinder 20 cm. in diameter. The first time the center, C, of rotation coincided with the center of the protected area. The result is shown on the left-hand half of Figure 11. Then, the center of rotation was moved 5 cm. outside of the center of the protected region. The distribution obtained is close to that of the first case, as shown by the second half of Figure 11.

#### SUMMARY

Geometric technics improving in two ways the distribution of ionization in rotational therapy are presented.

(a) *Protection of the Radiosensitive Organs:* The idea and the experimental results of protection of the spinal cord and the eyes by rotating an appropriate absorber, in synchronism with the patient, are shown in Figures 1-4. The application of the same idea in the case of a rotating source is shown in Figure 5.

(b) *Minimization of Dose to Healthy Tissue Surrounding the Treated Area.* Two variations of this technic of synchronous field shaping and the corresponding distributions of dosage are shown in Figures 6-9. It follows a geometric analysis proving that the relative position of the center of rotation with respect to the center of the treated region is of negligible importance in the distribution of ionization.

ACKNOWLEDGMENT: The development and application of the above technics would have been impossible without the guidance and help of Dr.

John G. Trump, Dr. Magnus I. Smedal, Mr. Kenneth A. Wright, and the other workers at the High Voltage Research Laboratory of the Massachusetts Institute of Technology. The writer welcomes the opportunity to express his deep gratitude and to record his thanks to these men.

## REFERENCE

PROIMOS, B. S.: Synchronous Field Shaping in Rotational Megavolt Therapy. *Radiology* **74**: 753-757, May 1960.

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## SUMMARIO IN INTERLINGUA

## Synchronone Protection e Modulation del Campo in Cyclotherapia

Es presentate technicas geometric que servi a meliorar in duo maneras le distribution del ionisation in therapia rotational.

(a) *Protection del organos radiosensibile*: Le idea e le resultados experimental del protection del columna dorsal e del oculos per rotar un appropriate absorptor in synchronia con le patiente es monstrate in Figuras 1, 2, 3, e 4. Le application del mesme idea in le caso de un fonte rotante es monstrate in Figura 5.

(b) *Minimalisation del dose al tissu san que circumjace le area tractate*: Duo variationes de iste technica del synchronone modulation del campo e del correspondent distributiones de dosage es monstrate in Figuras 6, 7, 8, e 9. Seque un analyse geometric que prova que le position relative del centro de rotation con respecto al centro del area tractate es de negligibile importantia in le distribution del ionisation.



# Life-Shortening in Mice Irradiated with Either Fission Neutrons or Cobalt-60 Gamma Rays<sup>1</sup>

HOWARD H. VOGEL, JR., Ph.D., NORMAN A. FRIGERIO, Ph.D., and DONN L. JORDAN, B.S.

DURING THE PAST decade the Neutron Toxicity Group has been investigating the biological effects of fission neutrons and Co<sup>60</sup> gamma rays on a variety of organisms (1). During the early years of the program, efforts were devoted largely to the study of the acute effects of single exposures of neutrons and gamma rays on mammals (2). The problem of lack of additivity of the two types of radiation was investigated; different modes of mortality were found following each, in mice, and different mechanisms of death were postulated (3).

The present experiments were carried out at the CP-5 research reactor to compare the results of earlier acute studies with those at lower dose levels. They were undertaken to evaluate the effects of a series of brief fractionated exposures ranging from the 30-day acute dose of both fission neutrons and Co<sup>60</sup> gamma rays, through the subacute area, to low total-dose levels. Such information will be useful in planning experiments in which animals will be exposed for the length of their lives in the low-level neutron room of the new "Janus" reactor. This reactor, now being built in Argonne's Division of Biological and Medical Research, should be in operation in the near future.

## EXPERIMENTAL STUDIES

1. *Mouse Longevity After 13 Brief Daily Exposures to Fission Neutrons and Co<sup>60</sup> Gamma Rays:* CF No. 1 female mice were received from Carworth Farms at five to six weeks of age and isolated for at least four weeks before irradiation. A total of 198 mice were used in the neutron experiment, shown in the left portion of Table I, while 158 were used in the gamma experiment, shown in the right half of the

table. The mice were randomly distributed in 6 exposure groups with an unirradiated control group for each type of radiation. All mice were irradiated in the gamma-neutron radiation chamber (4) at the CP-5 reactor. Each group of irradiated mice was exposed briefly to thirteen daily doses, varying from 30 seconds to 16 minutes *each day*. The neutron intensity at the animal positions was approximately 4.4 rads per minute; the gamma-ray dose rate from the Co<sup>60</sup> sources was approximately 13 rads per minute. Thus, although the gamma-irradiated and neutron-irradiated mice were exposed over equal periods, the former animals received a total dose three times that of the latter. The experimental plan was set up in this fashion, since the results of acute irradiation at the CP-5 reactor suggest that neutrons were approximately three times as effective as gamma rays, with the 30-day death being the criterion (5).

In Table I the numbers of mice per group and the daily radiation doses are listed for each radiation; the unirradiated controls form Group 0. The exposure time for each successive radiation group was doubled (1/2, 1, 2, 4, 8, and 16 minutes, for Groups 1 to 6, respectively). Survivors of all groups were observed to determine their longevity; death checks were made throughout the animal colony twice a day. All the mice were retained for the duration of their lives.

Mean survival times for all groups are included in Table I. The cumulative mortality of the various neutron-irradiated groups is plotted in Figure 1,A and can be compared with the gamma-exposed groups directly below (Fig. 1,B). The mice in Group 6, as expected, showed the

<sup>1</sup> From the Division of Biological and Medical Research, Argonne National Laboratory, Argonne, Ill. Work performed under the auspices of the U. S. Atomic Energy Commission. Presented at the Forty-sixth Annual Meeting of the Radiological Society of North America, Cincinnati, Ohio, Dec. 4-9, 1960.

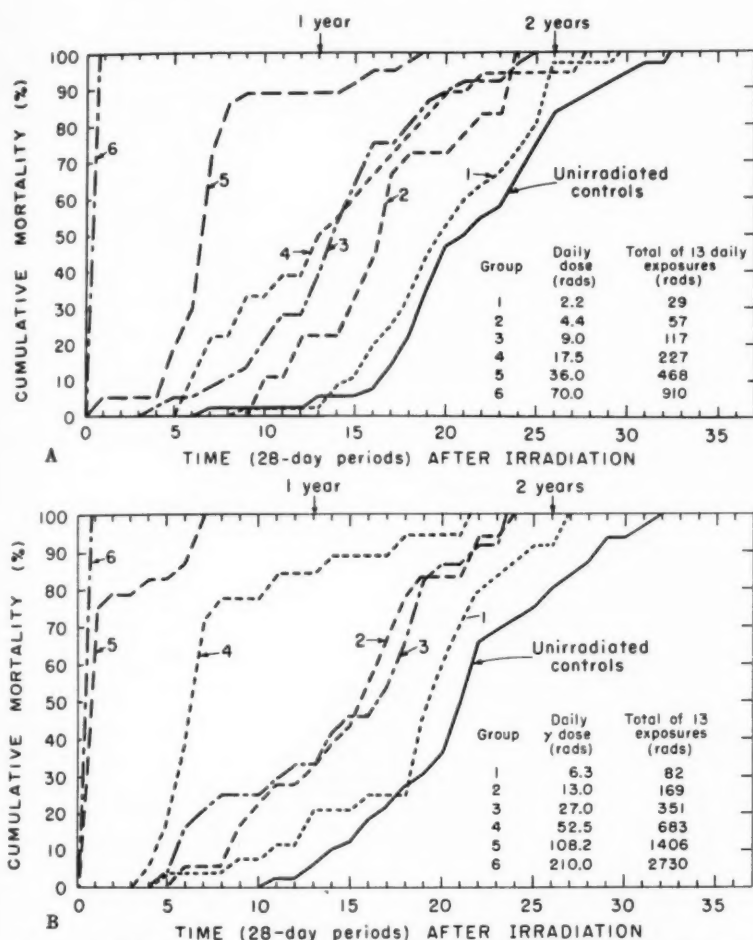


Fig. 1. Cumulative mortality in CF No. 1 female mice after thirteen daily exposures to doses of fission neutrons (A) or Co<sup>60</sup> γ-rays (B) in thirteen fractions. Mean survival times are given in Table I.

TABLE I: MEAN SURVIVAL TIMES OF MICE GIVEN THIRTEEN DAILY EXPOSURES TO DOSES OF FISSION NEUTRONS OR Co<sup>60</sup> γ-RAYS

Neutron-Irradiated					Gamma-Irradiated				
Group	No. Mice	Daily Dose (rads)	Total of 13 doses (rads)	Mean Survival Time (days) after Irradiation ± S.E.)	Group	No. Mice	Daily Dose (rads)	Total of 13 doses (rads)	Mean Survival Time (days) after Irradiation ± S.E.)
0	36	0	0	601.4 ± 24.7	0	32	0	0	594.5 ± 26.2
1	36	2.2	29	562.6 ± 21.1	1	24	6.3	82	515.5 ± 30.8
2	18	4.4	57	459.3 ± 31.1	2	18	13	169	416.6 ± 33.3
3	36	9.0	117	381.9 ± 23.8	3	24	27	351	406.3 ± 34.8
4	18	17.5	227	377.1 ± 40.2	4	18	52.5	683	222.6 ± 31.7
5	36	36	468	188.9 ± 17.9	5	24	108.2	1406	49.2 ± 12.2
6	18	70	910	16.0 ± 0.3	6	18	210	2730	14.3 ± 0.23

mortality pattern associated with acute single doses; all died within the first 30 days after exposure. A comparison

of the mean survival times listed in Table I together with the mortality curves in Figure 1 indicates that the larger the daily



TABLE II: ESTIMATED RBE (N/ $\gamma$ ) BASED ON SURVIVAL IN THE EXPERIMENTAL GROUPS

Daily Neutron Dose (rads)		Daily $\gamma$ -Ray Dose (rads)	Estimated RBE
2.2	is less effective than	6.3	2.9
4.4	is less effective than	13	
	but more effective than	6.3	1.5-3
9.0	is less effective than	52.5	
	but more effective than	25	2.6-5.8
17.5	is less effective than	52.5	
	but more effective than	25	1.4-3
36	is less effective than	108	
	but more effective than	52.5	1.4-3
70	is less effective than	210	
	but more effective than	108	1.4-3
323	Single acute dose, LD 50/30	902	2.8

dose of radiation, the shorter the average life span of the irradiated animals. There also is evidence (compare, for instance, Groups 4 and 5 in Table I) that the doses of gamma rays used are slightly more effective in decreasing life span than comparable doses of fission neutrons.

On the basis of work by Evans (6), Henshaw *et al.* (7), Mole (8), Furth *et al.* (9), Storer *et al.* (10), Noble *et al.* (11) and others, there seems little doubt that the relative biological effectiveness (RBE) of neutrons, in comparison with roentgen or gamma rays, is significantly elevated when animals are exposed to low levels of radiation for the length of their lives. The RBE (gamma/n) for mortality after single acute doses is usually 2 to 3; it may be as high as 5 to 10 after exposure to low dose rates for long periods. One of the objectives of the present experiment was to determine whether the RBE (gamma/n) is similarly elevated following a series of brief daily doses of the two forms of radiation.

The LD 50/30 for CF No. 1 female mice exposed to single whole-body doses at the CP-5 reactor was  $323 \pm 5$  rads of fission neutrons and  $902 \pm 5$  rads of  $\text{Co}^{60}$  gamma rays, hence the RBE (gamma/n) for acute 30-day lethality under our experimental conditions is 2.8. Table II compares the effectiveness of the thirteen daily doses of neutrons with that of  $\text{Co}^{60}$  gamma rays, in terms of longevity of the experimental groups of mice at the six dose levels tested. The evidence from this table and

TABLE III: RELATIVE BIOLOGICAL EFFECTIVENESS OF FISSION NEUTRONS AND  $\text{Co}^{60}$   $\gamma$ -RAYS IN REDUCING THE LIFE SPAN OF CF No. 1 FEMALE MICE GIVEN THIRTEEN DAILY DOSES OF RADIATION

Shortening of Mean Life Span (%)	Total Dose Fission Neutrons (rads)	Total Dose $\text{Co}^{60}$ $\gamma$ -Rays (rads)	RBE
90	800	1360	1.7
75	560	940	1.7
50	300	480	1.6
25	125	200	1.6
10	40	60	1.5

from the comparative mortality curves (Fig. 1) indicates clearly that the RBE (gamma/n) is *not* significantly elevated above the comparable figure of 2.8 obtained after single acute irradiations.

The effects of the thirteen daily exposures to the two forms of radiation on the life span of the CF No. 1 females are illustrated separately in Figure 2, in which the per cent life-shortening is plotted against total radiation dose. Both curves appear to indicate an exponential relationship between total dose and life-shortening. If the total neutron dose (rads) is multiplied by an RBE factor of 2.0, thus converting rad dose to rems, the neutron points will be seen to fit well on the gamma-ray curve of Figure 2 (in which rads are equivalent to rems).

In Table III are presented the comparative doses of the two radiations found necessary in this experiment to shorten the life span by specific percentages. Fission neutrons appear to be only 1.5 to 1.7 times more effective than  $\text{Co}^{60}$  gamma rays under the conditions of this experiment.

Thus, the RBE for these two forms of radiation is certainly not higher than the RBE figure (2.8) obtained for single acute exposures. Fractionation of the dose appears to lower the RBE slightly, as judged by shortening of the life span.

**2. Life Shortening in Mice Irradiated with Either Fission Neutrons or  $\text{Co}^{60}$  Gamma Rays at Low Dose Rates:** An experiment similar to that described in the previous section was carried out to test the effects of decreased dose rate of the two modes of

experimental plan, the radiation data, the mean survival times after first exposure, and the reduction of life span are given in Table IV.

The effects of the thirteen daily doses on life span of the irradiated mice are compared in Figure 3. From this graph it can be seen that fission neutrons were approximately 2.5 times as effective as  $\text{Co}^{60}$  gamma rays in reducing the life span by 50 per cent (925 rads, gamma; 370 rads, neutrons).

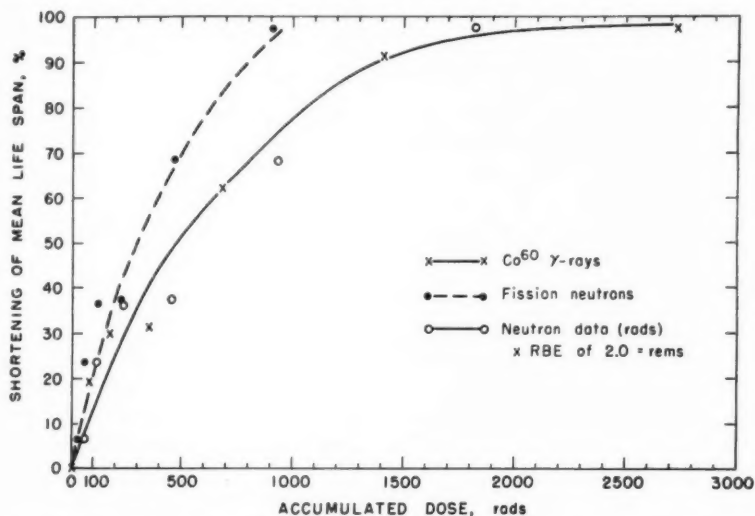


Fig. 2. Effect of total accumulated dose of  $\text{Co}^{60}$   $\gamma$ -rays and of fission neutrons (thirteen daily exposures) on life span in CF No. 1 female mice.

radiation on mouse longevity. Mice were exposed to daily doses of either fission neutrons or  $\text{Co}^{60}$  gamma rays, at dose rates of approximately 1 rad per minute. This low intensity was achieved for the gamma rays by increasing the distance between the 18  $\text{Co}^{60}$  sources and the animal position in the gamma-neutron radiation chamber (4), and for the neutrons by closing completely a 1/4-inch boral shutter (12) located between the reactor and the uranium converter plate. Five groups of mice were given thirteen brief daily exposures (3.75, 7.5, 15, 30, and 60 minutes) to each radiation, and the mean survival times after irradiation were compared with those for unirradiated control mice. The ex-

If one compares the results of this experiment, carried out at the low intensity of 1 rad per minute, with those of the experiment at higher dose rates, it becomes clear that the dose rate is much more important with gamma irradiation than with neutrons. In Figure 2 we find that approximately 300 rads of fission neutrons (at 4 to 5 rads per minute) are required to halve the mean survival time. In Figure 3, where the neutron dose rate is decreased to only 0.9 rad per minute, approximately 350 rads are needed to reduce longevity by 50 per cent. It appears, therefore, that the effect on life span of fission-neutron irradiation, in the range of intensities studied, is relatively independent

TABLE IV: LONGEVITY IN CF No. 1 FEMALE MICE EXPOSED TO THIRTEEN DAILY DOSES OF FISSION NEUTRONS OR  $\text{Co}^{60}$   $\gamma$ -RAYS AT DOSE RATES OF APPROXIMATELY 1 RAD PER MINUTE

Experimental Groups	No. Mice	Daily Exposure Time (min.)	Daily Dose (rads)	Total Dose of 13 Exposures (rads)	Mean Survival Time after First Irradiation (days $\pm$ S.E.)	Longevity (% of controls)	Reduction of Life Span (%)
1. Fission neutrons:							
0 (unirradiated controls)	51	...	...	...	486.3 $\pm$ 22.9	100	...
1	31	3.75	3.3	44	445.7 $\pm$ 24.6	92.0	8.0
2	31	7.5	7.0	87	457.7 $\pm$ 26.6	94.0	6.0
3	30	15	13.0	174	375.9 $\pm$ 23.7	78.6	21.4
4	32	30	27	349	240.8 $\pm$ 16.1	50.4	49.6
5	30	60	54	698	23.2 $\pm$ 3.9	4.8	95.2
2. $\text{Co}^{60}$ $\gamma$ -rays							
0 (controls)	48	...	...	...	493.1 $\pm$ 23.8	100	...
1	40	3.75	4.3	56	473.6 $\pm$ 17.0	96.0	4.0
2	40	7.5	8.6	111	485.8 $\pm$ 20.4	98.3	1.7
3	40	15	17	222	445.4 $\pm$ 22.5	90.3	9.7
4	39	30	34	444	331.7 $\pm$ 24.4	67.3	32.7
5	40	60	68	888	268.3 $\pm$ 28.4	54.4	45.6

TABLE V: IRRADIATION DATA FOR NEUTRON EXPOSURES (SINGLE vs. FRACTIONATED DOSES)

	Irradiation Time (min.)	Number of Mice	Estimated Dose Each Exposure (rads)	Mean After-Survival Time (days $\pm$ S.E.)
Single exposure	48	36	275	262.1 $\pm$ 20.3
Dose in 3 fractions	16*	36	96*	265.3 $\pm$ 25.6
Dose in 4 fractions	12*	36	69*	234.7 $\pm$ 18.3
Dose in 10 fractions	4.8*	36	27.5*	250.1 $\pm$ 22.3
Unirradiated controls	...	29	...	477.6 $\pm$ 32.0

\* Irradiation time for each fraction and dose for that fraction.

of dose rate. These data confirm earlier work in which it was reported that the acute LD 50/30 after single irradiations of mice with fission neutrons did not change significantly, whether the total dose was delivered in one and a half or twenty-four hours (13).

On the other hand, if one compares the two gamma-ray intensities (13 rads per minute and 1.1 rad per minute, Figs. 2 and 3, respectively), with respect to their effects on the mean life-shortening it is evident that for gamma rays the dose rate has a marked effect. At the higher dose rate, a total exposure of only 400 to 500 rads is necessary to shorten the mean life span by 50 per cent. When the dose is delivered at only 1 rad per minute we did not reach this 50 per cent level even at 888 rads, the highest total dose used.

When the reduction of life span after gamma irradiation at the low dose rate (Fig. 3) is compared with that for the high dose rate (Fig. 2), it is apparent that the low

intensity is much less effective in life-shortening. From the data in Table IV it is also clear that total gamma-ray doses up to 222 rads, at 1 rad per minute, do not significantly reduce life span, whereas a total dose of 169 rads, at 13 rads per minute, reduces the life span by almost a third. This dose-rate dependence of the gamma rays must lead to the different figures for RBE that were found in these two experiments.

3. *Effect on Mouse Longevity of Fractionation of a Dose of Fission Neutrons:* Four groups of 36 CF No. 1 female mice seven to eight weeks of age were irradiated with fission neutrons at the CP-5 research reactor, operating at approximately 1,500 kw. The dose rate of fission neutrons delivered to the mice in the gamma-neutron radiation chamber was approximately 6 rads per minute. The first group was irradiated with a single, whole-body exposure of approximately 275 rads of fission neutrons, a dose estimated to be sublethal

during the 30-day acute period. Actually 2 mice (5 per cent) died during this interval. The other three groups of mice were irradiated with the same total neutron dose delivered at the same intensity,

If the cumulative mortalities of the 144 mice of the four neutron-irradiated groups (upper four lines, Fig. 4) are combined and compared with those of the 29 unirradiated controls, several conclusions are evident:

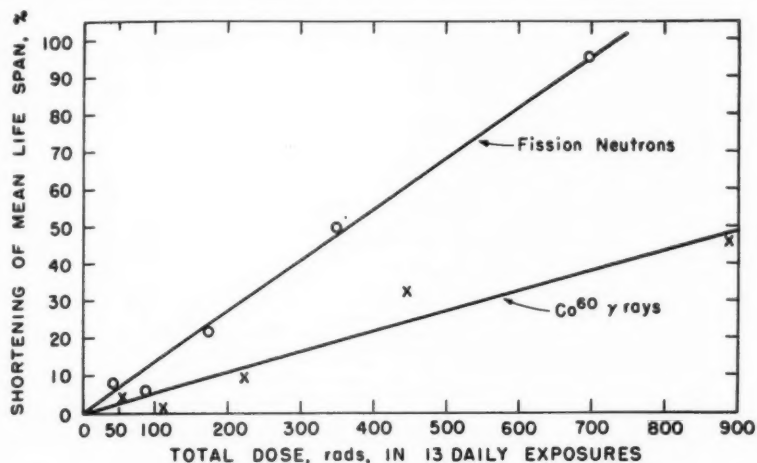


Fig. 3. Comparison of total dose (rads) in thirteen daily exposures of fission neutrons and Co<sup>60</sup> γ-rays delivered at low dose rate (1 rad per minute) on longevity of CF No. 1 female mice.

but the exposures were divided into three, four, and ten fractions respectively (see Table V). In all these groups, the exposures were made on separate days. For example, the ten fractional doses, each given in 4.8 minutes of daily exposure, were carried out within a period of two weeks.

Irradiation data and mean survival times after irradiation are listed in Table V. Figure 4 compares the cumulative mortality (per cent) of the four irradiated groups with that of the control mice for periods of 56 days after exposure. The mean survival time of the 29 unirradiated control mice in this experiment was 478 days from the time of first exposure of the neutron-irradiated mice, and the single, "sublethal" neutron exposure resulted in a decrease of approximately 45 per cent (Fig. 4). It seems clear from this graph and from the mean survival times after irradiation that there were no major differences in mortality patterns or average survival times between the single neutron exposure and fractionation of the dose into three, four, or ten separate daily exposures.

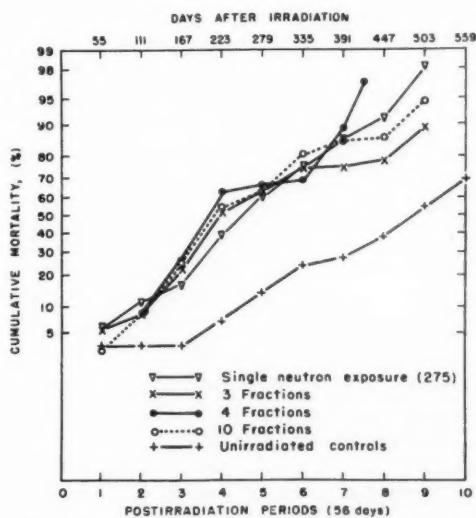


Fig. 4. The effect of fractionation of the dose of fission neutrons on longevity of CF No. 1 female mice. (Zero time figured from last fractionated irradiation).

1. During the first 225 days, deaths among the unirradiated controls are insignificant (less than 7 per cent), whereas more than half (76/144) of the irradiated

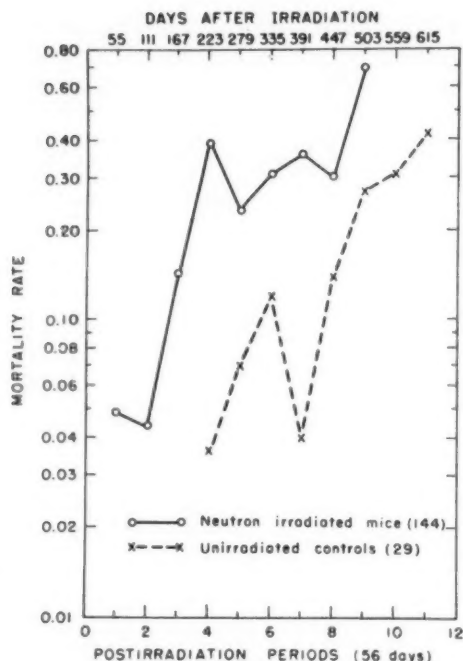


Fig. 5. Comparative mortality rates of neutron-irradiated mice and unirradiated controls for 56-day periods after exposure. Mortality rate: number of mice dying during each 56-day period divided by number of mice alive at the beginning of each interval.

mice are dead during the first four periods (Fig. 5).

2. The slope of the line representing combined cumulative mortality of irradiated mice appears to approximate the slope of the line representing the mortality of the unirradiated controls, at least from days 200 to 450 (Fig. 5). The line representing the neutron-irradiated animals is displaced by  $50 \pm 5$  per cent increased mortality above that of the unirradiated controls.

In Figure 5 the mortality rates for the 4 irradiated groups combined are compared with those of unirradiated control mice. The significant rise in the mortality rate of the irradiated mice during the second to fourth periods (111 to 223 days) was correlated with a marked increase in reticular tumors: both thymic and "generalized lymphomas" were found at autopsy in all four neutron-irradiated groups during this period. Fourteen of 15 mice autopsied

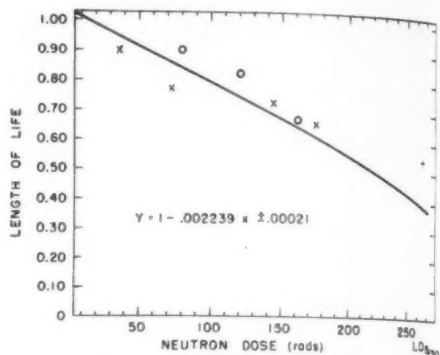


Fig. 6. The effects of single sublethal irradiation with fission neutrons on length of life in CF No. 1 female mice.

between 179 and 274 days after neutron irradiation showed either thymic gland involvement and/or splenomegaly, enlarged liver, or other evidence of lymphoma. Such thymic tumors appeared more frequently in the groups exposed to fractionated neutron doses than in the mice receiving only the single neutron dose. The oldest case in the neutron-irradiated mouse was observed at autopsy 334 days after exposure.

4. *Longevity of Mice Irradiated with Single Sublethal Exposures of Fission Neutrons:* In Figure 6 data on life span of irradiated CF No. 1 female mice were combined from three separate experiments: The three points represented by the circles in this graph were determined at one time (Experiment I). Three groups of 36 mice each were irradiated with a single whole-body exposure to neutrons at a dose rate of approximately 8 rads per minute. The exposure times were brief: 10, 15, and 20 minutes, respectively. Our purpose was to expose groups of mice to single doses roughly equivalent to  $1/4$ ,  $1/3$ , and  $1/2$  of the LD 50/30 dose (323 rads). As can be seen in the figure, there appears to be a linear relationship between the size of the dose and the decrease in longevity of the irradiated mice: the higher the dose, the shorter the life span. The mean survival times of these mice and the decrease (per cent) in their life spans are shown in Table VI.



TABLE VI: LONGEVITY IN FEMALE CF No. 1 MICE IRRADIATED WITH SINGLE SUBLETHAL EXPOSURES OF FISSION NEUTRONS AT DOSE RATES VARYING BY A FACTOR OF 40

Group	Proposed Dose	Irradiation Time (min.)	Neutron Dose (rads)	Number of Mice	Mean After-Survival Time (days $\pm$ S.E.)	Decrease Life Span (%)
I. Single neutron exposures (8 rads/min.)						
1.	1/4 LD 50/30	10	80	36	442.7 $\pm$ 23.3	9.2
2.	1/3 LD 50/30	15	120	36	398.6 $\pm$ 26.9	18.2
3.	1/2 LD 50/30	20	160	36	315.1 $\pm$ 23.1	35.4
4.	Unirradiated controls	0	0	19	487.4 $\pm$ 35.1	...
II. Single neutron exposures at low dose rates. Reactor operating at 50 kw. Dose rate = 0.2 rads/min.						
1.		180	36	47	498.5 $\pm$ 15.9	9.8
2.		360	72	48	425.7 $\pm$ 21.8	23.0
3.		720	144	48	402.2 $\pm$ 23.6	27.3
4.		870	174	48	362.7 $\pm$ 23.8	34.4
5.		1650	330	47	31.9 $\pm$ 10.9	96.0
6.	Unirradiated controls	...	...	40	552.8 $\pm$ 20.1	...
III. Single neutron exposure of 275 rads (Table V, top line)						
1.		48	275	36	262.1 $\pm$ 20.3	45.1
2.	Unirradiated controls	...	...	29	477.6 $\pm$ 32.0	...

In Experiment II the CP-5 reactor was operated at low power (50 kw instead of 2,000 kw) to yield a dose rate decreased by a factor of approximately 40; the mice were exposed to a neutron dose rate of approximately 12 rads per hour. The irradiation times varied from 3 to 27.5 hours (Table VI). This highest dose gave an acute lethal picture, 44 of 47 exposed mice dying within the first four weeks.

The four X's in Figure 6 represent the remaining irradiated groups in this experiment. The results appear to confirm the relationship between neutron dose and survival time shown by the first experiment. It would therefore appear that the total dose of fission neutrons is more important than the neutron intensity in reducing the life span, at least within a 40-fold intensity range.

The remaining point (+) in Figure 6 represents the mean survival time from Experiment III, in which 36 mice were exposed to 275 rads of neutrons in a single, whole-body dose delivered in 48 minutes (top line, Table V). In this case the life span was decreased by 45 per cent as compared to the unirradiated control mice of this experiment.

A single regression line was then fitted to these eight points, representing single

doses of fission neutrons from 36 to 275 rads. The line (Fig. 6) is represented by the equation<sup>2</sup>  $Y = 1 - 0.00224 \times \pm 0.00021$ . From these data it appears that a straight line with a negative slope of 0.22 represents the relationship between dose of fission neutrons and decrease in life span. It can therefore be stated that, under the conditions of exposure at the CP-5 reactor, the life span of female CF No. 1 mice was shortened approximately 0.22 per cent per rad of fission neutrons. This relationship between neutron dose and life-shortening appears to be linear, at least for neutron doses equivalent to 10 to 85 per cent of the LD 50/30 value.

#### DISCUSSION

Several investigators (6-11) have reported that if radiations are administered in small daily doses over a large fraction of the life span of rodents, the values of the relative biological effectiveness (RBE) of fast neutrons vs. gamma rays are increased. With shortening of the life span as one criterion, the RBE ( $\gamma/n$ ) may be as high as 10 to 15. Neary, Munson, and Mole (8) state that "a comparison of all available

<sup>2</sup> Points unweighted. If points are weighted, then  $Y = 1 - 0.002296 \times \pm 0.00021$ .

information on mortality of chronically irradiated mice suggests that the RBE for this effect is likely to be about 10." In contrast, the results of experiments comparing 30-day mortality following single acute exposures of the two radiations indicate that the value for RBE for these two forms of radiation probably lies between 2 and 3 (2, 5, 9, 10, 14, 15).

Evans (6) exposed Swiss mice to neutrons at Columbia University's 36-inch cyclotron. The mice were irradiated six times a week with a daily dose of 10 "N-units"<sup>3</sup>. The mean survival time for the group of 50 irradiated mice was approximately twenty-three days. This effect on survival was found to be the same after 80 r of x-rays per day as after 10 "N-units" daily. Evans also reported comparative results for acute exposures: 700 r were equivalent to 86 N (1 "N":8.1 r). Thus, in these experiments, 25 subacute neutron exposures produced effects quite similar to single acute irradiation, but different from daily chronic irradiation.

The difference between "acute" and "chronic" exposures appears to imply dissimilar rates of recovery between long-term neutron and x- or gamma-ray exposures of mice. It is interesting, therefore, that in earlier work, which tested recovery in mice after paired equal doses of fission neutrons separated by varying time intervals, we have indicated that recovery was indeed slower—by almost a factor of two—in neutron-irradiated mice than in similar animals exposed to comparable doses of Co<sup>60</sup> gamma rays (16). This lower acute recovery rate, however, may have no necessary bearing on the life-shortening efficacy relative to gamma rays.

For life-shortening following single whole-body exposures, fast neutrons have been reported to be about two to three times more effective per rad than gamma

rays in the LD 50 region (17). The results of our own irradiations at the CP-5 reactor confirm this value: RBE, 902 rads gamma radiation/323 rads fission neutrons = 2.8 (5). Thus, the RBE ratio for life-shortening after single exposures appears to be about the same as the RBE for acute lethality. This similarity has also been reported by Furth *et al.* (9) and Storer *et al.* (18).

Much of the existing data on mice and rats indicates that the effectiveness of single whole-body exposures to either roentgen or gamma rays for life-shortening, expressed as per cent reduction of life per 100 rads, increases as the dose increases (17). In contrast, the evidence presented in this paper suggests that life-shortening in mice irradiated with fission neutrons is approximately proportional to dose. *Consequently, the neutron RBE for life-shortening effect should increase as the dose decreases.*

In the first two experiments carried out in this series, mice were irradiated with small daily doses of neutrons and gamma rays during brief periods of exposure. The RBE values obtained were much closer to the values characteristic of single acute doses than to the higher figures reported for long-protracted irradiations. It is clear that there must be a shift in RBE values between the two-week daily exposures reported in these experiments and life-long irradiations at very low dose rates. It will be of interest to find out exactly where this change occurs, since the shift may have practical significance in both diagnostic and therapeutic radiology.

The results of our neutron experiments are in good agreement with recent work from Brookhaven National Laboratory reported by Curtis and Gebhard (15), who found, in three different experiments, that the RBE (fast neutrons *vs.* x-rays) was the same (1.7) for acute lethal effects in mice as for shortening of the life span. These involved either large single doses of the two radiations or smaller doses administered at 7-day or 14-day intervals. The authors concluded that "the relative recovery rates for neutrons *vs.* x-rays are

<sup>3</sup> The "N" is an arbitrary unit based on the ionization produced in the 25-r Victoreen chamber used by Evans. It should be noted that the unit (n), of other workers, is generally based on ionization in a 100-r Victoreen chamber. In general, the two do not agree (for neutron radiation) and there may be considerable variation from one chamber to another even when the size is the same.

different for small doses from those for large doses."

In the third annual Ciba Foundation Lecture (London, 1959), Upton reviewed much of the work, both experimental and theoretical, in the field of ionizing radiation and aging (19). He presented a figure representing mean survival time in mice after a single exposure to radiation early in life, excluding animals dying within 30 days. Mean survival time after gamma rays was compared with that after neutron exposures, based on data from a paper by Furth, Upton, and Kimball (20). The linear regression line drawn by Upton indicates a life-shortening of approximately 0.10 per cent per rad of fast neutrons, whereas our data for similar life-shortening after single sublethal doses of fission neutrons indicate a higher figure, 0.22 per cent per rad (Fig. 6). It might be pointed out that the regression line of Furth and Upton is based on only three neutron points. The two points below 200 rads in their data fit well with the linear regression line in Figure 6. The single point representing the highest neutron dose, approximately 265 rads, however, gives a higher survival time than a comparable dose in our experiment (0.75 vs. 0.55) and consequently changes the slope of the line. If this highest point were omitted, the data from the two experiments would be closely comparable and would be fitted well by the regression line in Figure 6. It is clear, however, from both these experiments that fast neutrons are several times more effective than gamma rays in shortening the life span of mice.

Small laboratory animals irradiated with comparatively small daily doses over long periods of time have been reported to suffer approximately 11 per cent life-shortening per 1,000 rads x-rays and about 5 per cent per 1,000 rads from hard gamma rays (17). Storer and Sanders (21) have reported that in white Swiss mice exposed to single graded doses of x-rays or thermal column radiation (thermal neutrons plus gamma rays), life-shortening amounted to about 5 per cent per 100 rads for either type of

radiation. Thus, the RBE of thermal-column radiation for life-shortening was unity ( $1.00 \pm 0.24$ ) for these two radiations, a value not significantly different from the RBE for the production of 30-day death. The equation for the linear regression line adequately fitting the points in the data of Storer and Sanders for both radiations was  $Y = 0.047X$ . The comparable equation representing the regression line in Figure 6 of this paper was:  $Y = -0.22X$ . (Our data for fission-neutron irradiation have been calculated on length of life; Storer's equation represents per cent shortening of life span, hence the difference in direction of slopes of the regression lines).

Several years ago Storer *et al.* (18) exposed female CF No. 1 mice to neutrons or mixtures of neutrons and gamma rays from an atomic detonation. They reported that fission neutrons shortened the life span by only 6.7 per cent per 100 rads. This value lies in the same range as those reported for their earlier studies with x-rays and thermal neutrons (21). It is clear from their data that the dosimetry under field conditions must have been different from that under our experimental conditions at a reactor: Mice in the field survived single neutron doses of 345 and 475 rads. Under our conditions, the former dose would be approximately an LD 80/30; after a fast neutron irradiation of 475 rads at the CP-5 reactor, there would have been no survivors of the 30-day acute period.

The energy of the neutron is an important factor (often underemphasized) in both lethality and longevity studies (22-24). Fission neutrons appear to be approximately five times as effective as thermal neutrons for the criterion studied: 200 rads of fission neutrons will shorten the life span of female mice by approximately 45 per cent, whereas the same dose of thermal neutrons or x-rays will decrease longevity by less than 10 per cent. Conger *et al.* (25) have also demonstrated this point by emphasizing the relationship of linear energy transfer and

RBE for chromosome and chromatid lesions in *Tradescantia* (25).

Data on long-term effects of radiation in man are still fragmentary. It is evident that we need more information on neutron irradiation of various mammalian species under different programs of fractionation, protraction, and intensity.

#### SUMMARY

1. Longevity was studied in CF No. 1 female mice exposed to daily doses of either fission neutrons or  $\text{Co}^{60}$  gamma rays at dose rates of approximately 4.4 and 13 rads per minute, respectively. Five groups of mice were given thirteen brief daily exposures (1/2 to 16 minutes per day) to each radiation, and the mean survival times after irradiation were compared with those for unirradiated control mice. The results from this experiment indicated clearly that the relative biological effectiveness, RBE ( $\gamma/n$ ), was not significantly elevated from the comparable figure of 2.8 obtained after single acute irradiations. The conclusion was that thirteen brief daily doses of these two types of radiation, delivered at relatively high intensities, did not produce the same effects as long-continued, life-long exposures at low dose rates. Fission neutrons appeared to be approximately twice as effective as  $\text{Co}^{60}$  gamma rays in shortening the life span of the female mouse.

2. In a similar experiment on mouse longevity, thirteen daily doses of the two forms of radiation were delivered at a much lower dose rate, approximately 1 rad per minute. Five groups of mice were given thirteen brief daily exposures (3.75, 7.5, 15, 30, and 60 minutes) to each form of radiation, and the mean survival times after irradiation were compared with those for unirradiated control mice. Fission neutrons were found to be two to three times as effective as  $\text{Co}^{60}$  gamma rays in reducing the life span by 50 per cent. This RBE figure did not differ significantly from that obtained by comparing the acute LD 50/30 doses (902/323 rads) after single exposures to the two radiations. The

effect of fission-neutron irradiation on life span, over the range of intensities studied in these two experiments, was relatively independent of the neutron dose rate. In contrast, these data emphasized the dose-rate dependence of  $\text{Co}^{60}$  gamma irradiation.

3. There seems to be no significant difference between mean survival times after a single sublethal exposure to fission neutrons (275 rads) and after fractionation of such a dose into three, four, or ten separate daily exposures. Comparison of mortality rates of the neutron-irradiated mice with those of the unirradiated mice indicated a significant rise in the mortality rate of the irradiated mice during the period of 111 to 223 days, apparently correlated with an increase in reticular tumors (thymic lymphomas). These lymphomas were found more frequently in the mice exposed to the fractionated doses than in those irradiated with a single whole-body exposure.

4. A linear relationship was postulated between single sublethal doses of fission neutrons (36 to 275 rads) and the length of life of the irradiated mice, expressed as per cent of unirradiated controls. In the CF No. 1 female mouse there appeared to be 0.22 per cent life-shortening per rad of fission neutrons (CP-5 research reactor, Argonne National Laboratory). This effect on mouse longevity was approximately five times higher than that reported by Storer (18, 21) per rad of x-rays, gamma rays, or thermal neutrons. The decreased longevity following single doses of fission neutrons was obtained even when the neutron dose rate was changed by a factor of approximately 40, emphasizing the dose-rate independence of fission neutrons compared with either roentgen or gamma rays.

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## SUMMARIO IN INTERLINGUA

Reduction del Longevitate in Muses Irradiate con Neutrones de Fission o con Radios Gamma ab Cobalt-60

Le longevitate de muses feminin CFI esseva studiate post exposition a doses diurne de (1) neutrones de fission e (2) radios gamma ab Co<sup>60</sup>, con un dosage de approximativamente 4,4 e 13 rad per minuta, respectivamente. Cinque grupos de muses recipeva dece-tres breve

expositiones diurne del un e del altere forma de radiation. Le relative efficacia biologic (gamma/n) non esseva significativamente elevate supra le comparabile cifra de 2,8 que habeva essite obtenite post unic irradiationes acute. Neutrones de fission pareva esser approximativamente



duo vices plus efficace que radios gamma ab  $\text{Co}^{60}$  in le reduction del longevitate de muses feminin.

In un simile experimento, dece-tres doses diurne del duo formas de irradiation esseva applicate a un multo plus basse nivello de dosage, de approximativamente 1 rad per minuta. Esseva trovate que neutrones de fission esseva duo a tres vices plus efficace que radios gamma ab  $\text{Co}^{60}$  in reducer le longevitate per 50 pro cento.

Le effecto de irradiation per neutrones de fission super le longevitate, inter le limites de intensitate studiate in iste duo experimentos, esseva relativamente independente del distribution del dosage. Per contrasto con isto, le datos revela un marcate dependentia del relative efficacia biologic ab le distribution del dosage in le caso de irradiation gamma ab  $\text{Co}^{60}$ .

Il pare exister nulle significative differentia inter le intervallos medie de superviventia post un sol exposition subletal a 275 rad de neutrones de fission e illos post le exposition fractionate al mesme dose in tres, quatro, o dece separate partes diurne.

Esseva postulate le existentia de un relation linear inter unic doses subletal de neutrones de fission in le campo ab 36 usque a 275 rad e le longevitate del irradiate muses, exprimate in pro cento del longevitate de non-irradiate muses de controlo. Le reduceite longevitate post doses unic de neutrones de fission esseva obtenite mesmo quando le dose esseva alterate per un factor de approximativamente 40. Isto accentua le independentia del efficacia de neutrones de fission ab le distribution del dose in comparison con radios roentgen o gamma.



# Cervical Spine Involvement in Lipoid Dermato-Arthritis<sup>1</sup>

WILLIAM MARTEL, M.D., MURRAY R. ABELL, M.D., and IVAN F. DUFF, M.D.

**L**IPOID dermatitis is a recently recognized, rare disease of unknown etiology, characterized by cutaneous nodules and chronic polyarthritis. An abnormality of lipid metabolism (1) has been implicated. Reticulohistiocytoma, reticulohistiocytosis, and reticulohistiocytic granuloma are synonymous terms. The histologic features of the nodules in the skin and synovial tissues are diagnostic and consist of infiltrates of characteristic histiocytes and multinucleated giant cells, possessing abundant eosinophilic, finely granular or homogeneous cytoplasm. Solitary or multiple nodules may occur without arthritis but the latter has been present in the majority of patients with multiple cutaneous lesions (2). The peripheral joints often show progressive changes with widespread destruction of the cartilage and subchondral bone, resembling severe rheumatoid arthritis (2, 3). The present case is reported to illustrate and emphasize the involvement of the cervical spine.<sup>2</sup>

## CASE REPORT

J. D., a 38-year-old white woman, noticed pruritic "bumps" on the arms, elbows, hands, face, and neck in 1951. Xanthelasma of the eyelids also appeared at that time. Painful arthritis developed in the left knee several months later, and soon the other knee and both ankles were affected. Within one year the hips, elbows, wrists, and hands were similarly involved. The arthritis progressed so rapidly that the patient was confined to a wheel chair in 1953. Shortening of the fingers occurred over a period of four years with gradual decrease of pain in the hands. The cutaneous lesions persisted. Dryness and coarseness of the skin and hair suggested hypothyroidism, for which she was treated with desiccated thyroid for several years.

The patient was first seen at The University of Michigan Medical Center in 1958 with complaints of severe, aching pain in the joints of the extremities and generalized body tenderness. Urinary frequency, nocturia, and polydipsia had been present

for two years. The blood pressure was 140/98. The skin of the face and dorsum of the hands was coarsened, erythematous, and scaling. Slight periorbital edema and bilateral xanthelasmas of the eyelids were noted. Flesh-colored, subcutaneous nodules, up to 5 mm. in diameter, were seen along the nasal margins and in the hands, and were sparsely scattered over the entire body. The thyroid gland was not enlarged on palpation. The heart, lungs, and abdomen were normal. The elbows, shoulders, hips, knees, and ankles were tender and swollen, due to thickening of the articular soft tissues and increased joint fluid. Severe shortening and hypermobility of the fingers were noted, with redundancy and telescoping of the skin ("opera glass hands"). Several joints of the feet were also involved. The cranial nerves and deep tendon reflexes were normal and pathologic reflexes were not elicited. Generalized muscle weakness and hyperesthesia were present over the entire body, except for the hands which were almost insensitive to touch.

The hemoglobin was 12.4 gm. per cent, the sedimentation rate was 35 mm. in an hour (Westergren), and the leukocyte count was 8,000/c. mm., with 6 per cent eosinophils. The lupus erythematosus cell test, Kahn serologic test, and serologic tests (sensitized sheep cell, latex fixations, and bentonite flocculation) for the rheumatoid factor were negative. The antistreptolysin-O titer was normal and the C-reactive protein was 2 plus. Total serum protein (electrophoresis) was 6.6 gm. per cent and the albumin/globulin ratio was 4/2.6. The serum calcium, phosphorus, and alkaline phosphatase values were normal. The total serum cholesterol was 198 mg. per cent, with 48 per cent as esters. The total blood lipid and phospholipid values were normal. The fasting blood sugar was 275 mg. per cent. Urinalysis showed 2+ glycosuria.

Roentgenograms disclosed spectacular resorption of the phalanges with a resultant foreshortening of the fingers and telescoping of the soft tissues in ring-like folds (Fig. 1). The distal tips of the terminal phalanges were relatively intact, but the radiocarpal, intercarpal, and metacarpophalangeal joint spaces were narrowed with destruction of the subchondral bone. Similar, though less marked, arthritis with periarticular bone destruction was present in the feet, with slight periosteal new bone formation along the shafts of several metatarsals. Severe joint destruction with periarticular bone resorption was also observed in the scapulohumeral and acromioclavicular

<sup>1</sup>From the Departments of Radiology, Pathology, and Internal Medicine, The University of Michigan, Ann Arbor, Mich. Accepted for publication in February 1961.

<sup>2</sup>Presented in an exhibit at the Sixty-first Annual Meeting of the American Roentgen Ray Society, Atlantic City, N. J., Sept. 27-30, 1960.

<sup>3</sup>The clinical features in this case have previously been described (4).



Figs 1-2. 1958.

Fig. 1. Dramatic resorption of the phalanges with foreshortening of the fingers and telescoping of the soft tissues. There is destruction of cartilage and bone in the radiocarpal, intercarpal, and metacarpophalangeal joints.

Fig. 2. Bony fusion with obliteration of the sacroiliac joints. The femoral heads are destroyed and there is severe protrusion of the acetabula. There are erosions of the ischial margins.

joints, the elbows, ankles, knees, and hips. There were severe protrusions of the acetabula, bony fusion of the sacroiliac joints, and erosions of the ischial margins (Fig. 2). The posterior lumbar and costo-

vertebral joints were not clearly seen. There were no paraspinal ossifications of the type found in ankylosing spondylitis.

An excision biopsy of one of the skin lesions in 1951

(Fig. 3) encapsulated dermis. rated from connective tissue and finely granular nuclei while the division

variation of histiocytes. Persistent tissue changes. Some of the cells were plasma cells. wrinkled appearance of histiocytes. giant cells. less numerous. similar. created classic the lesions were s

(Fig. 3) disclosed a roughly circumscribed but non-encapsulated mass of histiocytic cells within the dermis. The overlying epidermis was thin and separated from the lesion by a narrow zone of collagenous connective tissue. The basic cells, which were polygonal and of medium size, possessed pale eosinophilic, finely granular but nonfoamy cytoplasm. The nuclei were vesicular and uniform in appearance, while the nucleoli were sharply defined. Occasional division figures were identified and there was some

finer than the cells of the main mass. The blood vessels throughout the dermis were numerous and dilated. A second skin lesion, excised in 1958, closely resembled the initial one. The pathologic diagnosis was reticulohistiocytoma.

In view of the severe involvement of the peripheral joints, simulating "mutilating" rheumatoid arthritis, it was of interest to learn whether the cervical spine was similarly involved. The patient was recalled specifically for this purpose in April 1960.

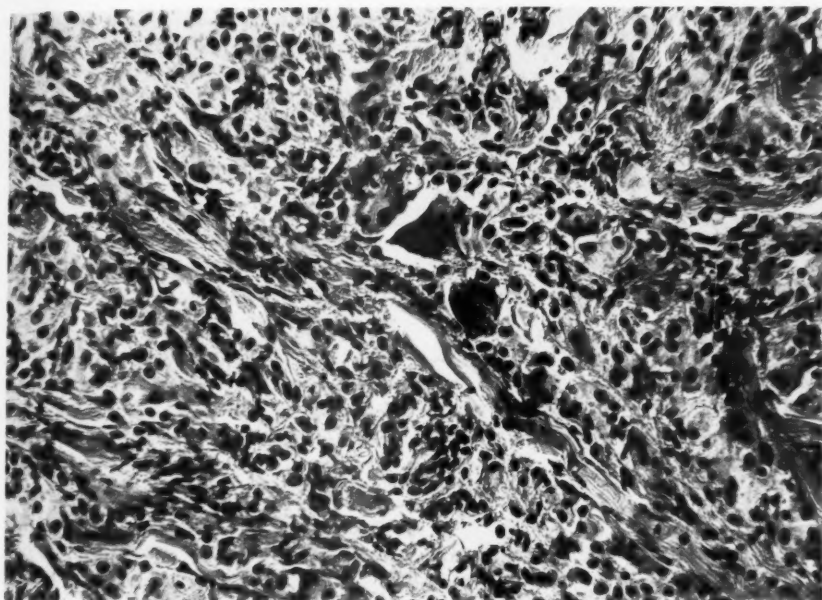


Fig. 3. A section of the initial lesion excised from skin. There are numerous mono- and binucleated histiocytes separated by persistent bands of collagenous connective tissue. Two shrunken multinucleated giant cells with hyperchromatic nuclei are present near the center of the field. Hematoxylin and eosin  $\times 144$ .

variation in size of the cells and nuclei, but the cellular features were not those of a malignant neoplasm. Persistent bands of mature collagenous connective tissue extended between groups of histiocytic cells. Some of the cells were binucleated, a few trinucleated, and others contained many nuclei. These giant cells were of two types: the more frequent form possessed deep-stained, somewhat basophilic cytoplasm and the nuclei were dark, small, shrunken, or wrinkled; the nucleoli could not be seen. The appearance of these giant cells suggested a coalescence of histiocytic elements which had then proceeded to degenerate. The less frequent form of multinucleated giant cells had pale, finely granular cytoplasm, and less numerous nuclei which were slightly larger but similar to those of the mononucleated and binucleated histiocytes. There were no giant cells of the classical Touton type. In the dermis adjacent to the lesion, and especially about the blood vessels, were similar but smaller histiocytes, less well de-

Lateral views in flexion and extension and lateral laminagrams were obtained. These showed destruction of the atlas, odontoid process, superior part of the body of C-2 and possibly the tip of the basilar process (Fig. 4). An irregular bone fragment, presumably derived from these structures, was situated in the spinal canal adjacent to the basilar process. A remnant of the posterior arch of C-1 was visible. McGregor's line (5), from the hard palate to the occipital curve (the tip of the odontoid should not extend more than 4.5 mm. above this line), passed through the inferior margin of the body of C-2 and the foramen magnum-clivus angle (normal upper limit,  $136^\circ$ ) (6) was  $152^\circ$ . The basilar process appeared short. There was minimal malalignment of the cervical vertebrae at several levels in flexion and slight reduction in the height of the intervertebral disk between C-2 and C-3. Films of the pelvis disclosed erosions of the symphysis pubis in addition to the previously described abnormalities.



Fig. 4. Cervical spine, April 1960. Lateral midline laminogram. There is destruction of the odontoid process, atlas, and, possibly, the tip of the basilar process. A bony fragment (arrow) lies in the spinal canal behind the axis. The foramen magnum-clivus angle is wide.

The patient was last seen in December 1960. Her general health was good and considerable improvement in the use of her extremities had followed intensive physical therapy. She experienced occasional diplopia, blurring of vision, and dysphagia. There was atrophy of the deltoid and gluteus muscles bilaterally, but the deep tendon reflexes were normal and there were no cerebellar or pyramidal tract signs. The cranial nerves were normal and there was no sensory loss. In the opinion of the neurologist, there were no objective neurologic abnormalities. She had approximately 50 per cent reduction in the range of motion of the neck, but motion in the dorsolumbar spine and chest expansion were not significantly compromised. Laminograms disclosed slight further erosion of the remainder of the body of C-2 and a lytic lesion in the body of C-3.

#### DISCUSSION

The roentgen findings in this case mimic those seen in severe rheumatoid arthritis ("arthritis mutilans"). Erosions of the cervical vertebrae, especially of the odontoid process, and cervical subluxations, particularly of the atlanto-axial joints, have been described in classic rheumatoid arthritis (7, 8). In such patients there may develop extensive destruction of the

lateral masses of C-1, occipital condyles, and anterior margin of the foramen magnum, permitting the skull to descend on the spine. Erosion of the tip of the basilar process, causing foreshortening of the latter, may give the appearance of a widened foramen magnum-clivus angle. This condition has been termed "pseudobasilar invagination" because the weight-bearing portion of the skull is probably eroded rather than invaginated (7). Similar changes are present in our patient. Although such severe cervical bone destruction as is shown in this case was not observed in rheumatoid arthritis, the pattern of involvement is the same. It is of interest that there were no significant neurologic manifestations.

The obliteration of the sacroiliac joints (2) and erosions of the posterior articulations of the dorsolumbar spine (3) have previously been described in lipid dermat-arthritis. Its appearance differs from that in ankylosing spondylitis in that paraspinal ossifications (syndesmophytes) and subchondral sclerosis at the sacroiliac joints have apparently not been noted. Narrowing and obliteration of the sacroiliac joints and erosions of the symphysis pubis and ischial tuberosities may also be seen in classic rheumatoid arthritis (9).

Cutaneous lesions without joint involvement have been described (2) and it is interesting to speculate whether the reverse can occur. Apparently the lesions in the skin may regress or disappear (1, 2). In view of the radiologic similarity with rheumatoid arthritis, these cases could easily be mistaken for that disease since the correct diagnosis depends on biopsy of the skin or joint lesions.

#### SUMMARY

A case of lipid dermat-arthritis with involvement of the cervical spine and the peripheral and sacroiliac joints is described. The similarity of the roentgen findings in the spine in this disease and in severe rheumatoid arthritis is emphasized.



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## SUMMARIO IN INTERLINGUA

## Affection del Spina Cervical in Dermato-Arthritis Lipoide

Es reportate un caso de affection del spina cervical in dermat-arthritis lipoide in un femina de 38 annos de etate. Symptommas esseva primo notate in 1951, sed il esseva solamente in 1958 que le autores videva le patiente. A ille tempore, roentgenogrammas revelava un resorption spectacular del phalanges con resultante accurtation del digitos e repression del tissu molle in forma de plicas anular. Le punctas distal del phalanges terminal esseva relativemente intacte, sed le spatios del articulationes radio-carpal, intercarpal, e metacarpo-phalangee esseva restringite e le osso subchondral esseva destruite. Un simile ben que minus marcate arthritis con destruction de osso periarticular esseva presente in le pedes. Sever destruction articular con resorption de osso periarticular esseva etiam observate in le articulationes scapulohumeral e acromioclavicu-

lar e in le cubitos, cavilias, genus, e coxas. Sever protrusion del acetabulos esseva presente e fusion del articulationes sacroiliac si ben como erosion del margines ischial.

In 1960 expositiones lateral in flexion e extension e laminogrammas lateral del spina cervical monstrava destruction del atlante, del processo odontoide, del parte superior del corpore de C-2, e possibilemente del puncta del processo basilar. Un fragmento irregular de osso, presumiteamente derivate ab iste structuras, esseva situate in le canal spinal adjacente al processo basilar. Le angulo inter foramine e clivo esseva 152°.

Es sublineate le similitude del constatactiones roentgenologic in le spina in iste morbo con illos in severe arthritis rheumatoide. Le correcte diagnose depende del biopsia del pelle e del lesiones articular.

# The Solitary Dense Vertebral Body<sup>1</sup>

JOHN M. DENNIS, M.D.

**O**STEOSCLEROSIS or increased density of the spongiosa of the vertebral bodies is observed in various diseases. The sclerosis may sometimes be diffuse and give the impression of an "ivory vertebra" as the spongiosa is replaced by an amorphous homogeneous bony mass. In other cases, the spongiosa is atrophic with only increased prominence of the trabeculae or it is replaced by dense, spotty, irregular masses of bone (1). While osteosclerosis is frequently observed in several lower dorsal or lumbar vertebral bodies, its limitation to a single vertebral body is a rather unusual finding.

During the past several years in the

Department of Radiology of the University Hospital (University of Maryland), we have been interested in the solitary dense vertebral body and to date have collected 16 cases. Eight of these were due to focal Paget's disease, 6 to lymphomatous involvement, and 2 to metastatic cancer. Of the 6 cases secondary to lymphomatous involvement, 5 were microscopically diagnosed as Hodgkin's disease, and the other as reticulum-cell sarcoma. Solitary dense vertebral bodies have also been ascribed to Kummell-Verneuil vertebral disease, sprue, and pachyderma (1), but we have encountered no such cases.

Based upon necropsy material, the in-

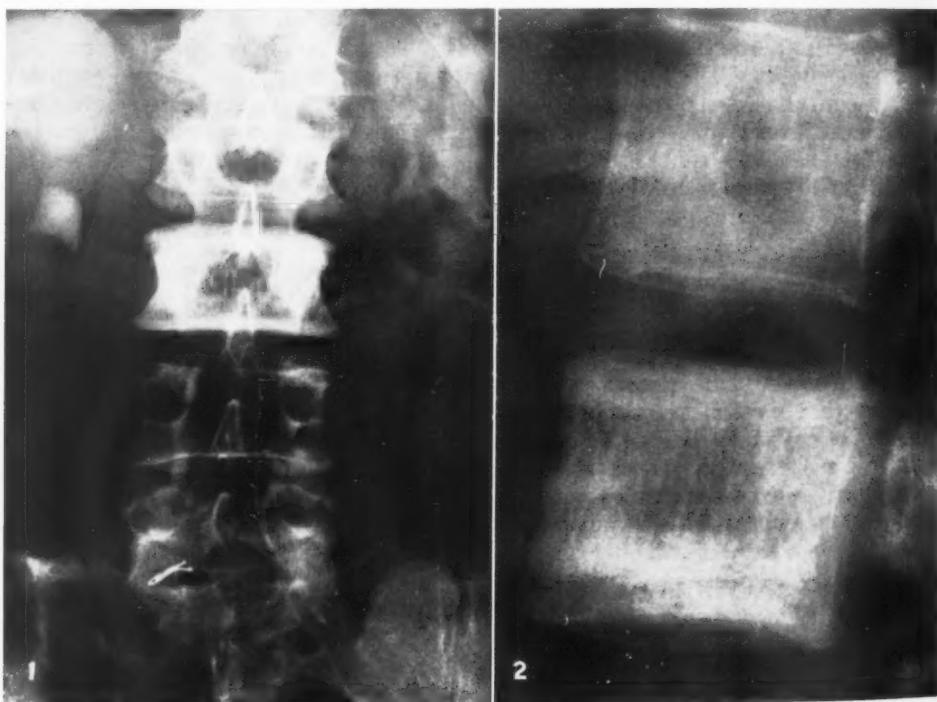


Fig. 1. Paget's disease involving a single vertebral body. The increased density is produced by the coarse prominent vertical trabeculations typical of this disease.

Fig. 2. Paget's disease involving a single vertebral body in which there is not only a coarsening of the vertical trabeculations, but also subcortical sclerosis producing a double contour.

<sup>1</sup> From the Department of Radiology, University Hospital, University of Maryland School of Medicine, Baltimore, Md. Accepted for publication in February 1961.

Fig. 3. Proved osteoblastic vertebral.

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Fig. 3. M. R., a 41-year-old white female with proved generalized Hodgkin's disease. A marked osteoblastic response is limited to the third lumbar vertebra.

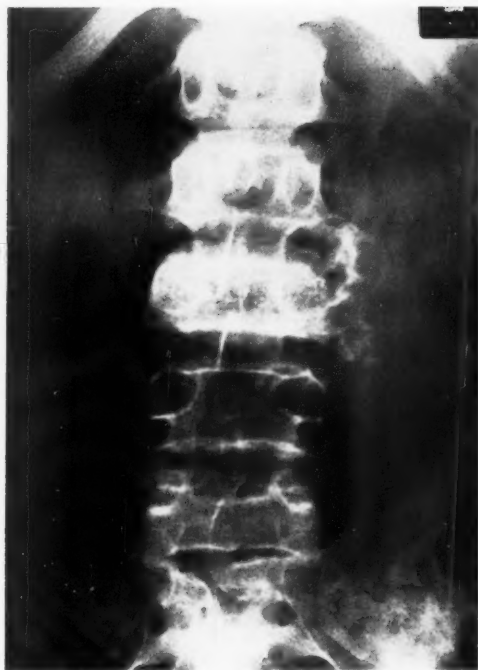


Fig. 4. J. C., a 14-year-old colored male. The diagnosis of Hodgkin's disease was made by the radiologic staff from the osteoblastic activity both within the third lumbar vertebra and in the surrounding soft tissues. The diagnosis was later proved by a biopsy of a retroperitoneal lymph node. At the time of surgery, the retroperitoneal lymph nodes were contiguous with and inseparable from the vertebral body.

cidence of Paget's disease is from 3.0 to 3.7 per cent in patients over the age of forty. It may remain focal in about 1 out of 10 cases, the spine being the most common site of focal involvement. Delitalia in 1946 found Paget's disease localized exclusively to a single vertebra in 10 of 110 cases studied roentgenologically (2-3). Such solitary involvement of a vertebral body may be a late stage of evolution and not an early phase of the disease (3).

In Paget's disease, there is atrophy of the spongiosa, evident roentgenologically as extraordinary coarse vertical trabeculations or a subcortical sclerosis. In this small series, involvement of a single vertebral body by Paget's disease was typical of that elsewhere in the osseous system (Fig. 1). The vertical trabeculations were quite coarse and in some cases subcortical sclerosis produced a double contour, or "picture-frame" character of the vertebra (Fig. 2). In 6 of the 8 cases, the anteroposterior diameter of the involved vertebra was increased and in 4 there was evidence of Paget's disease elsewhere in the pelvis or hips.

The skeletal system is involved in approximately 40 to 50 per cent of lymphoma cases. This involvement, however, is frequently demonstrated only at necropsy and not roentgenologically. Schinz observed osseous foci in the vertebrae of 65 of 100 postmortem cases, but in only 35 of these were they evident roentgenologically. Often there was widespread destruction of the spongiosa of the vertebral body without roentgen evidence (1).

Lymphomatous foci develop in the vertebrae through the blood stream and by a contiguous invasion of the periosteum and bone by the lymphomatous process in neighboring lymph nodes. Hematogenous foci usually develop in multiple vertebrae, rarely in one. Contiguous involvement of the vertebrae is more com-



Fig. 5. Osteoblastic metastases limited to the body of the fourth lumbar vertebra. The primary lesion was a squamous-cell carcinoma of the nasopharynx. Note that the osteoblastic involvement is punctate and confluent, in contrast to involvement by Paget's disease and lymphomas.

mon in the lower dorsal and upper lumbar areas, and is more likely to be limited to one vertebral body than is the involvement secondary to hematogenous foci (1).

Roentgenologically, lymphomatous deposits in the single vertebral body in this series were quite dense and amorphous in appearance due to the marked osteoblastic response in the spongiosa (Fig. 3). In 2 cases, there was evidence of osteoblastic activity extrinsic to the involved vertebra, with irregular bony proliferation externally along one or more margins (Fig. 4). At operation in the case illustrated this extrinsic osteoblastic activity was found to be the result of contiguous involvement of the vertebral body by the surrounding

diseased lymph nodes which were surgically inseparable from the vertebral body.

Osteoblastic metastases of the spine are more commonly secondary to carcinoma of the prostate, but may be due to other causes. Metastatic cancer of the spine usually involves several vertebrae, and involvement of a single vertebra is unusual. In this small series, we found osteoblastic metastases limited to a single vertebral body in only 2 cases, the primary lesions being carcinoma of the nasopharynx and colon. The osteoblastic involvement of these single vertebrae was roentgenologically the same as in cases with multiple vertebral involvement and was not as homogeneous as was observed in the lymphoma cases (Fig. 5); the osteoblastic areas were punctate and confluent.

#### SUMMARY

In the differential diagnosis of solitary dense vertebral body, three diseases should usually be considered: (a) Paget's disease, (b) lymphoma, and (c) metastatic cancer. Roentgenologically, involvement of a single vertebral body by Paget's disease is typical of that elsewhere in the osseous system. Lymphomatous involvement produces a diffuse homogeneous sclerosis of the involved body in contrast to the prominent trabeculations, increased size, and double contour of the vertebral body in Paget's disease and the patchy osteosclerotic involvement in metastatic cancer. The presence of osteoblastic activity extrinsic to a dense vertebral body is quite characteristic of lymphoma.

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## SUMMARIO IN INTERLINGUA

## Densitate de Solitari Corpores Vertebral

Dece-sex casos de osteosclerosis limitate a un sol corpore vertebral esseva colligite al Departamento de Radiologia del Hospital del Universitate Maryland in le curso de recente annos. In 8 le causa esseva focal morbo de Paget, in 6 affection lymphomatose (5 con morbo de Hodgkin e 1 con sarcoma reticulocytic), e in 2 cancro metastatic ab carcinoma del nasopharynge e del colon respectivamente.

Roentgenologicamente le affection de un sol corpore vertebral per morbo de Paget

es typic de ille affection in altere partes del systema ossee. Le affection lymphosarcomatose produce un diffuse sclerosis homogenee del corpore in question, per contrasto con le prominente trabeculationes, le augmento del dimensiones, e le duple contorno del corpore vertebral in morbo de Paget e con le non-uniforme affection osteosclerotic in cancro metastatic. Le presentia de activitate osteoblastic extrinsec al dense corpore vertebral es satis characteristic de lymphoma.





# Idiopathic Azygos Phlebectasia Simulating Mediastinal Tumor<sup>1</sup>

WILHELM Z. STERN, M.D., and ALLAN E. BLOOMBERG, M.D.

THE ROENTGEN appearance of the normal azygos vein was first described by Ottonello in 1932. It casts an ovoid or almond-shaped shadow in the right tracheobronchial angle, seen to best advantage on frontal laminagrams of the chest. The width of the normal azygos vein in adults has been reported not to exceed 6 mm. (Fleischner and Udis).

Dilatation of the azygos vein has been described under various pathologic circumstances, including right-sided heart failure, portal venous hypertension, obstruction of the superior or inferior vena cava, and absence of the inferior vena cava. Particularly in the latter case, the azygos and hemiazygos venous systems may serve as important collateral channels for return of blood to the right side of the heart.

It is our purpose to record the case of a healthy 19-year-old white male who was rejected from military service because a routine induction chest roentgenogram revealed a "mediastinal tumor" (Fig. 1). At a subsequent exploratory thoracotomy, a huge azygos vein was found. Since this patient did not present any of the previously described conditions which could account for such dilatation, we rather reluctantly were forced to a diagnosis of "idiopathic azygos phlebectasia," realizing that a peculiar venous obstruction in the portal system or elsewhere in the abdomen had not been entirely excluded.

## CASE REPORT

L. P., a 19-year-old white male, had always been in excellent health. On induction into military service in January 1960, a routine chest roentgenogram showed a "right mediastinal mass," and he was therefore rejected. He was admitted to Montefiore Hospital on Feb. 22, completely asymptomatic. His past history revealed only a tonsillectomy in childhood. The entire physical examination was within normal limits.

The roentgenographic work-up consisted first of films of the chest in frontal, oblique, and lateral pro-

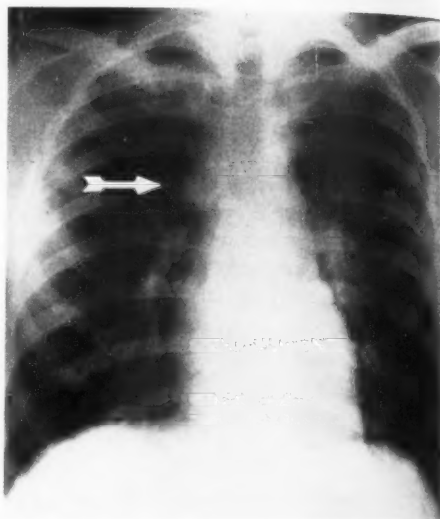


Fig. 1. Postero-anterior roentgenogram of the chest, showing an abnormal ovoid density in the right tracheobronchial angle.

jections, with a barium swallow to outline the esophagus. There was no abnormal esophageal indentation, and the possibility of a right-sided aortic arch, or a double aortic arch, was thus excluded. Subsequent laminagrams (Fig. 2) clearly demonstrated an ovoid soft-tissue density in the right tracheobronchial angle, without calcification in or about the lesion. There was no evidence of bronchial compression.

For further evaluation, an intravenous angiocardio-graphic study was performed on Feb. 24. A spheroid radiolucent defect, measuring almost 3 cm. in diameter, was noted in the lower portion of the superior vena cava, on its posterior aspect (Figs. 4 and 5). There was no reflux of opaque medium into this soft-tissue structure.

Although we were aware of the possibility of an azygos phlebectasia, the findings were erroneously interpreted as representing an extrinsic indentation on the superior vena cava, probably due to enlarged lymph nodes. Consideration was given to sarcoidosis, lymphoma, tuberculous or non-specific lymphadenitis, and a bronchogenous cyst.

On March 2, an exploratory thoracotomy was performed. As the apex of the lung was retracted toward the diaphragm, a huge azygos vein came into view. At its entrance into the superior vena cava, it measured 3.2 cm. in diameter. The tributaries coming from the upper part of the chest seemed

<sup>1</sup> From the Divisions of Diagnostic Radiology and Surgery, Montefiore Hospital, New York, N. Y. Accepted for publication in February 1961.

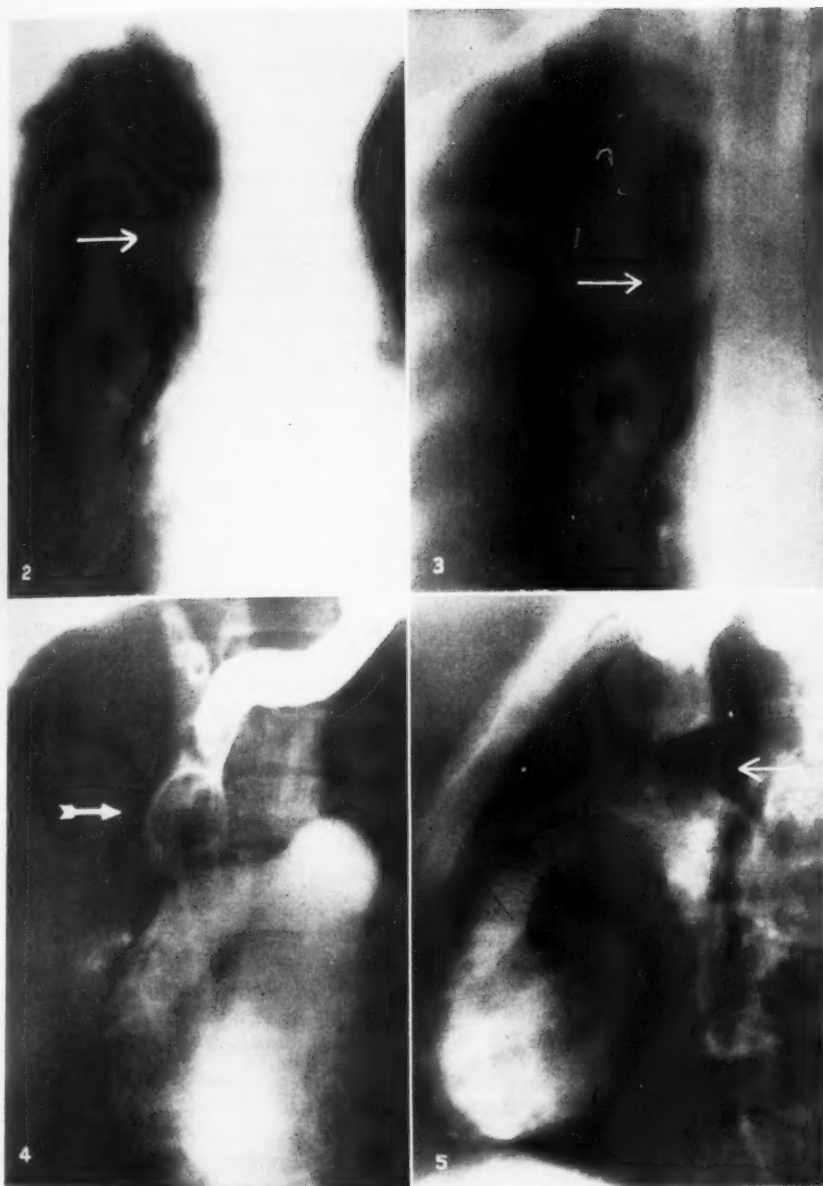


Fig. 2. Anteroposterior laminagram at a distance of 9 cm. from the back, showing to better advantage the abnormal ovoid density in the right tracheobronchial angle, which proved to be a huge azygos vein.

Fig. 3. Normal chest for comparison. Laminagram 9 cm. from the back. The typical almond-shaped image of the azygos vein is clearly seen in the right tracheobronchial angle. Due to distortion by the laminagraphic technique, the width of the azygos vein can exceed a diameter of 6 mm., which is considered the upper limit of normal for the image of the azygos vein on a standard roentgenogram.

Fig. 4. Intravenous angiogram, frontal projection. Dilution effect in the inferior portion of the superior vena cava, due to entrance of non-opacified blood from the azygos vein.

Fig. 5. Simultaneous lateral projection of angiogram showing the dilution effect on the posterior aspect of the superior vena cava, in its lower portion. There is no reflux of opaque medium into the azygos vein.



Fig. 6. Serial film of same angiocardigraphic study as shown in Figs. 4 and 5 demonstrating the opaque medium flowing through the superior vena cava, at the junction with the azygos vein. The radiolucent defect, therefore, is not constant as would be expected with a mass, but is, rather, intermittent and consistent with a dilution defect. Two seconds later, the entire bolus of contrast medium had passed beyond the superior vena cava into the heart and pulmonary circuit.

larger than normal, and the azygos itself ascended on the posterior wall of the right hemithorax as a very large structure. At the diaphragmatic level, it measured approximately 2 cm. in diameter. Pains-taking exploration of the mediastinum revealed no other mass or space-occupying lesion. The pericardium was opened anterior to the phrenic nerve, at the base of the heart, and the inferior vena cava was palpated within the pericardium. The inferior vena cava measured approximately 2 cm. in diameter, was obviously carrying blood, and was readily compressible.

The postoperative recovery was uneventful.

A few months later the patient was recalled and an attempt was made to opacify the azygos vein by intraosseous venography, as described by Schobinger. Intracostal injection of contrast medium resulted in prompt visualization of intercostal veins, but no satisfactory opacification of the azygos was obtained.

#### DISCUSSION

In the literature one finds several criteria differentiating between a dilated

azygos vein and an enlarged lymph node. The image of the azygos vein tends to be more ovoid, "pumpkin seed-," or "almond-shaped," while the enlarged lymph node is rather spheroid. An increase in intrathoracic pressure (Valsalva maneuver) will not affect the relatively solid lymph nodes, but will sometimes lead to a decrease in size of the more easily compressible azygos vein. Conversely, the azygos vein becomes more prominent during the Müller maneuver. It appears larger in the supine or Trendelenburg position, when it is better distended, than in the upright position.

We would like to stress the almost constant visualization, in the average-sized adult, of the azygos vein on frontal chest laminagrams obtained in the supine position, at a distance of about 8 to 11 cm. from the back (Fig. 3). In any patient with a right paratracheobronchial mass density, in whom the normal image of the azygos vein cannot be identified on laminagraphy, the possibility of an azygos phlebectasia should be considered. Such cases can be further evaluated by means of intraosseous venography (injection of contrast medium into a lower rib or spinous process) in an attempt to opacify the azygos vein.

#### SUMMARY

A case of idiopathic azygos phlebectasia in a 19-year-old male, rejected from military service because of a suspected mediastinal tumor, has been presented. At surgical exploration the superior and inferior vena cava were found to be normal and there was no evidence of heart failure or any other disorder to account for the dilated azygos vein.

The almost constant visualization of the normal azygos vein on frontal laminagraphy of the chest is emphasized, and the diagnostic roentgen criteria for azygos phlebectasia are described.

ACKNOWLEDGMENT: We thank Dr. Harry E. Karounos of Brooklyn for referring this patient to us.

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## SUMMARIO IN INTERLINGUA

## Idiopathic Phlebectasia Azygos, Simulante Tumor Mediastinal

Es presentate un caso de idiopathic phlebectasia azygos in un masculo de 19 annos de etate qui esseva rejicite per le servicios militar a causa del suspicion de un tumor mediastinal. In le exploration chirurgic il esseva trovate que le vena cave superior e inferior esseva normal. Esseva trovate nulle signo de discompensation cardiac o de un altere disordine que haberea potite explicar le dilatate vena azygos.

Es emphasitate le quasi constante visualisation del normal vena azygos in le laminogrammas frontal del thorace. Le

roentgeno-criterios diagnostic pro phlebectasia azygos es describite. In omne caso de un patiente con densitate de massa paratracheobronchial al latere dextere, in qui le imagine normal del vena azygos non pote esser identificate laminographicamente, le possibilitate de un phlebectasia azygos deberea esser prendite in consideration. Tal casos pote esser evalutate additionalmente per medio de venographia intraossee (injection de substantia de contrasto ad in le costa inferior o ad in le processo spinose), in un effortio de opacificar le vena azygos.



## Venous Anomaly of the Hemiazygos System<sup>1</sup>

GERHARD H. HOFFMAN, M.D., VERNON O. LARSON, M.D., GEORGE A. SHIPMAN, M.D.,  
and CHARLES SPARGER, M.D.

OF THE CASES of dilatation of the hemiazygos venous system simulating mediastinal tumors that have been reported in recent years, 2 were aneurysmal and associated with portal hypertension. The case reported by Leigh *et al.* (5) in 1954 was seen roentgenographically and confirmed at postmortem examination. In the second instance, Campbell and Baruch (2) described the findings at exploratory thoracotomy.

In his excellent description of the azygos and hemiazygos systems, Abrams (1) noted many variations in the anatomy of the systemic venous return. The case to be recorded here apparently represents a most unusual variant, as we found no strictly similar example in the current literature.

### CASE REPORT

A 49-year-old Honduran, fireman on a native ship, was initially seen for rib fractures that occurred in October 1959. Routine roentgenograms obtained on Jan. 15, 1960, showed a mass in the posterior mediastinum, measuring 0.5 X 2.5 cm. A system review and physical examination disclosed no significant abnormalities apart from those due to the left rib fractures. Extensive laboratory studies were negative.

**Röntgen Findings:** On the roentgenogram there appeared a retrocardiac mass adjacent to the aorta, which was thought to represent a small aortic aneurysm. Dorsolumbar spine films showed no erosion. Fluoroscopy and an upper gastrointestinal series revealed no abnormalities of the stomach or esophagus. No varices were demonstrated. The mass was thought not to vary in size and was difficult to see at fluoroscopy. Anteroposterior tomograms showed it to be separate from but immediately adjacent to the lateral aspect of the aorta. It could not be identified on routine lateral chest views or on lateral tomograms. Retrograde aortography showed no aortic abnormality at the site of the mass. A diagnosis of posterior mediastinal tumor of unknown etiology was made.

**Operative Findings:**<sup>2</sup> On July 21, 1960, an exploratory left thoracotomy demonstrated an elongated, tortuous, dilated intercommunicating vein about the lower thoracic aorta, presenting as a mass. This



Fig. 1. Postero-anterior chest film showing faint rounded density adjacent to the retrocardiac aorta (arrows).

vein joined the otherwise normal hemiazygos system and extended to the esophageal hiatus. There was no evidence of esophageal varices. The vein was dissected free of the aorta and transected proximally at its connection with the hemiazygos vein and distally just above its passage through the hiatus. The postoperative course was uneventful. The microscopic sections were reviewed by Dr. Theodore L. Perrin, pathologist, whose diagnosis was phlebectasia and phlebosclerosis with aneurysmal dilatation of the hemiazygos venous system.

### DISCUSSION AND SUMMARY

A most unusual anomaly of the hemiazygos vein presented as a posterior mediastinal mass attached to the aorta. The venous dilatation in this case was not a single saccular aneurysm (7), but an apparent cluster of intercommunicating, thin-walled veins closely adherent to the aorta. Anomalies of the hemiazygos ve-

<sup>1</sup> From the Departments of Radiology (G. H. H., V. O. L., G. A. S.) and Surgery (C. S.), U. S. Public Health Service Hospital, Staten Island, N. Y. Accepted for publication in April 1961.

<sup>2</sup> This case is being presented elsewhere from the surgical aspect.



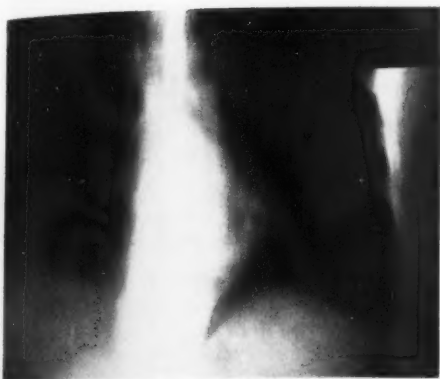


Fig. 2. Anteroposterior tomogram demonstrating the mass closely adjacent to the aorta.



Fig. 3. Retrograde aortogram showing the mass adjacent to the aorta, but without involvement of the aortic lumen.

nous system should be considered in a differential diagnosis of posterior mediastinal masses that are demonstrated not to be a part of the aorta, gastrointestinal tract, or diaphragm, and that do not produce changes of the adjacent vertebrae.



Fig. 4. A view of the operative field showing the dilated veins (above the tip of the clamp) adjacent to the thoracic aorta above the diaphragm.

Aneurysms of the azygos and hemiazygos systems usually occur with congestive heart failure, increased portal venous pressure, anomalous pulmonary venous drainage, obstruction or absence of the inferior or superior vena cava, or persistence of the left superior vena cava (1, 4, 6, 9). The venous enlargement in this case was be-

lieved to be congenital (3). No roentgenograms prior to October 1959 were available for comparison.

As in previously recorded cases, the condition might have been made recognized preoperatively had azygography been considered. The method of Schwartz, Handel, and Candel (8), with bilateral

simultaneous injections into the posterior eighth or ninth ribs, might have established the diagnosis and made thoracotomy unnecessary. Fluoroscopy with Valsalva and Müller maneuvers, in this case, was not helpful to the extent described for larger aneurysms seen in the azygos-hemiazygos systems (2).

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#### SUMMARIO IN INTERLINGUA

##### Anormalitate del Systema Hemiazygos

Es reportate un caso in que un inusualissime anomalia del vena hemiazygos se presentava como un massa postero-mediastinal attachate al aorta. Esseva trovate in iste caso que le dilatation venose consisteva non de un sol aneurysmo saccular sed apparentemente de un racemo de venas intercommunicante con tenue pa-

rietes que adhereva intimemente al aorta. Anormalitates del systema de venas hemiazygos deberea esser considerate in un diagnose differential del categoria de massas postero-mediastinal que non forma parte del aorta, del vias gastrointestinal, o del diaphragma e que non produce alterationes del adjacente vertebrae.



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# Amniotic Pulmonary Embolism<sup>1</sup>

H. R. ARNOLD, M.D., J. E. GARDNER, M.D., and P. H. GOODMAN, M.D.

SINCE the original article on amniotic pulmonary embolism by Steiner and Lushbaugh in 1941, numerous other papers on the condition have appeared in the literature. We have been unable, however, to find anything in the radiologic literature regarding the roentgen features. This may be due partially to the rarity of

The blood count and urinalysis were within normal limits. Labor was induced by pitocin, and the patient, with a vertex presentation, was delivered with low forceps after two and a half hours of labor. Only a minimal amount of inhalation anesthesia was used.

Immediately following delivery, a cough and wheeze developed, which soon subsided. Extreme restlessness and progressive dyspnea, not relieved

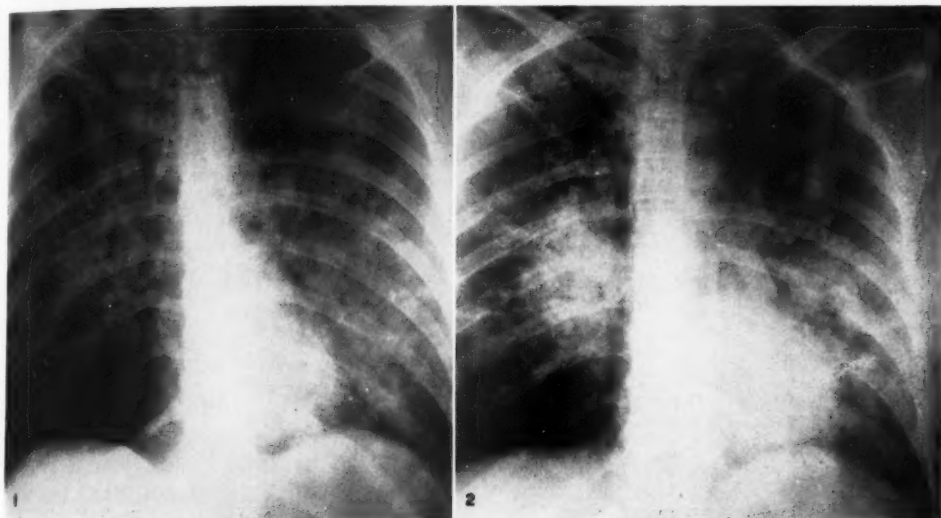


Fig. 1. Sept. 9, 1959. The initial film of the chest, six hours after the onset of acute symptoms, showing heavy bilateral perihilar infiltrations.

Fig. 2. Sept. 10, 1959. The infiltrations have become more confluent in the perihilar zones.

the occurrence and also to the fact that death frequently ensues before radiographs can be obtained.

Recently we had the opportunity of following a case of nonfatal amniotic pulmonary embolism and were able to study its radiographic features.

## CASE PRESENTATION

A 34-year-old white primigravida had several hospital admissions for hyperemesis during her pregnancy, the course of which was otherwise uneventful. On Sept. 9, 1959, she was admitted to the hospital for induction of labor.

Physical examination on admission was negative.

by oxygen, followed, and the patient was seen to be in acute distress. The pulse was extremely rapid and thready, with a definite pulsus alternans. Respiration was approximately 60 to 80 per minute, and the blood pressure was 100/60. There was moderate generalized cyanosis. Examination of the chest revealed fine inspiratory râles in the left base. The heart rate was extremely rapid; the heart, however, did not seem to be enlarged.

Roentgenograms were made and will be described and discussed below.

An electrocardiogram, obtained soon after the onset of the acute episode, showed only a sinus tachycardia. A repeat tracing, approximately ten days later, was interpreted as indicating myocardial damage or pulmonary infarction.

The white blood count on Sept. 10 was 18,950,

<sup>1</sup> From the Department of Radiology, Spohn Hospital, Corpus Christi, Texas. Presented before the Texas Medical Association, Galveston, Texas, April 24, 1961. Accepted for publication in February 1961.

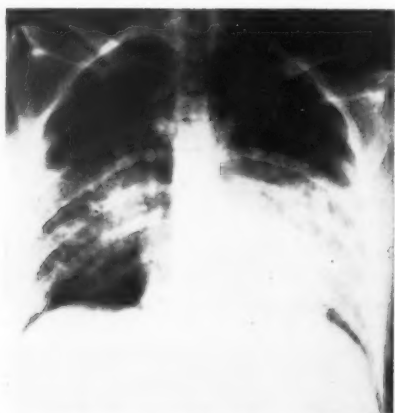


Fig. 3. Sept. 11, 1959. The heart now shows a moderate degree of enlargement. The infiltrations are beginning to undergo resolution in the peripheral areas of the lungs.

with 57 segmented and 26 stab forms, 9 lymphocytes, 3 monocytes, and 5 juveniles. The hemoglobin was 14.0 grams per 100 ml. and the hematocrit was 45 per cent. Urinalysis showed sugar 1+ and albumin 1+. There was a positive acetone reaction, and the microscopic examination demonstrated many red blood cells, hyaline and granular casts, and 2 to 5 white blood cells per high-power field. A sputum examination on Sept. 12 showed gram-positive cocci and gram-negative rods along with budding yeast in a smear. A culture yielded *Staph. albus*, *Candida albicans*, and *Klebsiella pneumoniae*.

Under treatment by digitalis, aminophyllin, antibiotics, sedation, steroids, anticoagulants, and oxygen, the patient exhibited progressive improvement and recovered sufficiently for discharge after two weeks.

#### PATHOGENESIS

The development of amniotic pulmonary embolism requires: amniotic fluid trapped under pressure and entrance into the maternal venous circulation. The first condition is probably the result of rather hard labor contractions with the membranes ruptured and the head blocking the cervical os. This forces the amniotic fluid into the opening in the maternal circulation. The second condition could result from any one of several occurrences, including rupture of the uterus, premature separation of the placenta, cesarean section, or laceration of the uterus, cervix, or placenta.

#### PATHOLOGY

Grossly the lungs appear edematous, and the pleural cavity usually contains a small amount of clear fluid. Microscopically, emboli composed of epithelial cells, amorphous debris, and mucin are found in the arterioles and capillaries of the lungs.

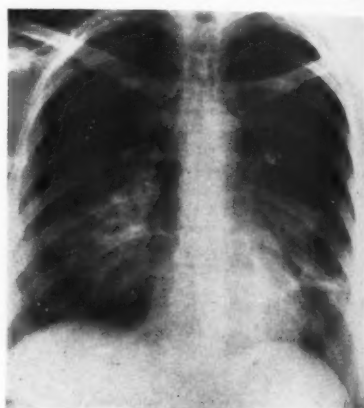


Fig. 4. Sept. 21, 1959. The heart has returned to normal and the infiltrations show further resolution. Areas of focal atelectasis are now evident in both lungs.

Also, there is alveolar edema with a variable amount of hemorrhage into the alveoli. In addition to the pulmonary findings, the vascular obstruction in the lungs leads to right heart strain and, possibly, ultimate heart failure.

#### CLINICAL FEATURES

The usual clinical picture is that of acute respiratory distress and shock following a hard labor with strong uterine contractions. During or immediately following delivery, cough and dyspnea develop. Restlessness and anxiety ensue. The patient shows a variable degree of shock and cyanosis. Examination of the lungs usually reveals the presence of fine inspiratory râles. The overall clinical picture is that of acute pulmonary edema.

If the patient survives the initial episode of shock, a hemorrhagic tendency may develop in three to six hours. It is theorized that this is due to defibrinogenation of the blood by amniotic fluid, which contains a thromboplastin-like material.

It may also be the result of the body's production of fibrinolysin to remove the emboli.

#### DIAGNOSIS

The diagnosis of amniotic pulmonary embolism is primarily clinical, supported by the x-ray and electrocardiographic findings.

In the event of death and refusal of autopsy, the diagnosis may be established by withdrawing blood from the right heart, which will reveal epithelial cells and amorphous elements from the amniotic fluid.

During this period, areas of streak atelectasis appeared in both lung fields, which gradually subsided along with the infiltrations. In addition to the pulmonary involvement, there was evidence of slight cardiomegaly, indicating the presence of heart strain. A follow-up film obtained three and one-half months following the delivery showed the lung fields to be completely clear, with no residual changes. The explanation for the rather unusual distribution of the infiltrations seen in the radiographs is suggested by Oderr *et al.* in their microradiologic studies on pulmonary emphysema. The application of this re-

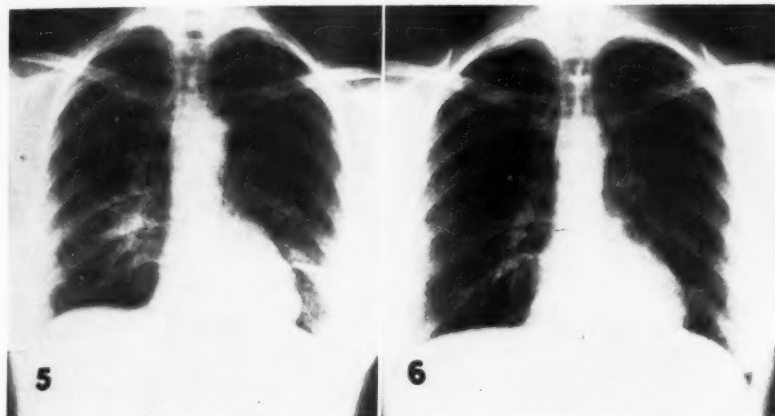


Fig. 5. Sept. 30, 1959. The infiltrations and atelectasis show almost complete resolution.

Fig. 6. Dec. 30, 1959. No residual abnormalities are evident.

From the clinical standpoint, the differential diagnosis includes other forms of embolization, aspiration pneumonitis, cardiac failure, toxemia, and acute adrenal insufficiency with vascular collapse.

#### RADIOGRAPHIC FEATURES

In the case presented above, diffuse bilateral infiltrations were shown on a chest film approximately six hours after the onset of the acute distress. In the initial films the infiltrations were mottled in character, with a tendency to be confluent. They showed a perihilar distribution, sparing the peripheral portions of the lungs. Clearing was gradual, over a twenty-one-day period, beginning at the periphery and extending toward the hilus.

search to explain the pattern of other pulmonary diseases was recently pointed out by Barden in his article, "Reflections of Disease in the Pulmonary Medulla." It is pointed out by these authors that there are many more capillaries in the medullary portion of the lung than in the cortical portion, which makes it clear why the infiltrations seen in this particular condition assume a perihilar type of distribution, resembling that seen in uremia, periarteritis nodosa, and transfusion reaction.

Although the radiographic appearance is not diagnostic, it is sufficiently characteristic that one should immediately suspect the diagnosis in acute respiratory distress and shock following delivery.



## SUMMARY

1. A case of amniotic pulmonary embolism is presented.

2. The pathogenesis of this condition requires: the trapping of amniotic fluid under pressure and entrance into the maternal venous circulation.

3. The lungs show embolization of the arterioles and capillaries with alveolar edema and hemorrhage. The heart may be enlarged due to right heart strain and failure.

4. The clinical picture is that of acute respiratory distress and shock during or immediately following delivery. Hemorrhagic phenomena may or may not ensue.

5. The diagnosis is primarily clinical, supported by the x-ray and electrocardiographic findings.

6. The characteristic roentgen findings consist of bilateral perihilar infiltrations, the distribution of which is related to the

capillary distribution found in the lung.

NOTE: Acknowledgment is made of the research assistance given by Miss Donna Schlembach, Librarian, Driscoll Foundation Childrens' Hospital, Corpus Christi, Texas.

1214 Santa Fe  
Corpus Christi, Texas

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## SUMMARIO IN INTERLINGUA

## Amniotic Embolismo Pulmonar

Un caso de amniotic embolismo pulmonar esseva observate radiographicamente ab le inception usque al restablimento. In un pellicula del thorace, obtenite approximativemente sex horas post le declaration de acute angustia respiratori, diffuse infiltrationes bilateral esseva notate, de character maculate sed con le tendentia de confluere. Le distribution esseva characteristicamente perihilar, e le portiones peripheric del pulmones esseva exempte. Le accleration del pulmones occurreva gradualmente in le curso de un periodo de vinti-un dies, comenciante in le peripharia e progredente verso le hilo. A parte le affection pulmonar, un leve

grado de cardiomegalia esseva observate. Un pellicula de controlo subsequente, exponite tres menses e medie post le parturition, monstrava que le campos pulmonar esseva completamente clar.

Le disveloppamento de iste morbo require le trappation de liquido sub pression e le entrata de illo in le circulation venose del matre. Le usual tableau clinic es illo de acute angustia respiratori e de choc post sever labores con forte contractiones uterin. Hemorrhagia pote sed non debe occurrer. Le diagnose es primariamente clinic, supportate per le constationes roentgenographic e electrocardiographic.

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## Television Bronchography<sup>1</sup>

CHAPIN HAWLEY, M.D., FERNANDO L. MENDEZ, M.D., and ELMER R. MAURER, M.D.

BRONCHOGRAPHY under television control has proved to be an excellent and simple method of obtaining bronchograms at the Christ Hospital, Cincinnati, Ohio. It expedites and facilitates the handling of the patient and permits the operator to work in a lighted room rather than in the practically total darkness necessary for fluoroscopy. Not only is *no dark adapta-*

residents and other personnel. With a remote monitor, the procedure can be observed elsewhere in the hospital for teaching or other purposes.

Premedication is paramount if one is to achieve good topical anesthesia of the tracheobronchial tree. One of the barbiturates, preferably pentobarbital, is given an hour and a half before the examination.



Fig. 1. Bronchography under television control.

tion needed, but the patient is much less apprehensive in the lighted room.

Intubation of the trachea and bronchi can be carefully controlled, since the physician and his assistant can simultaneously watch the position of the tube on the television screen. Technicians can move about freely. The assistant easily controls the patient, as well as the amount of opaque material being injected.

The use of television during bronchography is an excellent medium for instructing

In addition to this, morphine, 1/4 to 1/6 gr., combined with atropine, 1/100 gr., for its antisecretory and bronchodilatory effect, is administered approximately forty-five minutes before the procedure. Dihydrocodeinone bitartrate 1/2 gr. is given orally to suppress the cough reflex.

The patient is brought to the radiology department on a stretcher. Four to five cubic centimeters of 1 per cent topical tetracaine is injected transtracheally, just above Burns' notch, and the patient is

<sup>1</sup> From the Departments of Radiology and Thoracic Surgery, The Christ Hospital, Cincinnati, Ohio. Accepted for publication in March 1961.

allowed to cough up this material. This technic produces good aerosolization of the tetracaine with resultant anesthesia of the tracheobronchial tree, the larynx, and the epiglottis. Additional anesthesia is carried out with a topical spray of 1 per cent tetracaine, in order to anesthetize the pharynx. Next, a small rubber (or plastic) catheter is led through the nares. With the head tilted backward, the chin tilted upward, and the tongue retracted forward, the tracheobronchial tree can be opened easily for introduction of the catheter into the larynx. Once this is done, an additional 2 to 3 c.c. of 1 per cent tetracaine is instilled into the tracheobronchial tree by positioning the patient so that the flow will be properly directed. This completes the anesthesia.

The patient is next transferred to the x-ray table and a technician is assigned to control the catheter and instill the material being used to outline the tracheobronchial

tree. With the lights on and the television camera functioning, the operator can then direct the catheter into the appropriate areas. With adequate positioning of the patient, the entire tracheobronchial tree can be clearly outlined. The middle lobe and lingula are visualized easily by tilting the table downward. The catheter is moved from the right to the left side if necessary. Following visualization of the tracheobronchial tree, the appropriate radiographs are obtained, and the catheter is removed from the larynx and nasal passages. The patient is then positioned so as to encourage removal of all possible traces of the bronchographic material before return to his room.

The use of television makes bronchography a very simple procedure, with advantages for the patient, the physician, and his assistants.

The Christ Hospital  
Cincinnati 19, Ohio

#### SUMMARY IN INTERLINGUA

##### Bronchographia Televisional

Bronchographia a direction televisional se ha provate un excellente e simple methodo. Viste que omne le manipulationes es executate in un camera illuminate,

nulle adaptation al obscuritate es requirite, e le apprehension del patiente es diminuite. Es describe le premedication, le anestesia, e le technica del injection.



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## WORK IN PROGRESS

### Photoscanning of Bone Lesions Utilizing Strontium 85<sup>1</sup>

LIEUT. CMDR. WILLIAM H. FLEMING, MC, USNR<sup>2</sup>  
LIEUT. CMDR. JAMES D. McILRAITH, MSC, USN  
and CAPT. E. RICHARD KING, MC, USN

With the technical assistance of M. S. BREEN, HM2, USN

THE metabolism of strontium 85 in man has been extensively studied by Bauer and colleagues (1, 2). Significant localization in bone of strontium 85 occurs in fractures, metastatic cancer, eosinophilic granuloma, chondromas, osteomyelitis, and Paget's disease. Quite recently, Gynning *et al.* (3) reported the usefulness of skeletal strontium-85 localization for detection of carcinoma metastatic from the breast. We should like to call attention here to the feasibility of photoscanning selected skeletal areas which harbor localized strontium 85.

#### TECHNIC

Strontium 85 was obtained from Oak Ridge National Laboratory. The isotope was in an acid solution of approximately one normal and had a specific activity greater than 500 millicuries per gram. Purity was of the order of 98 per cent, with less than 1 per cent strontium 89. The stock solution was prepared by first neutralizing with 3 per cent sodium hydroxide and diluting the strontium 85 in physiologic saline to 20 microcuries per milliliter. This solution was then passed through a Millipore bacterial filter<sup>3</sup> to insure sterility. Twenty microcuries were given intravenously to selected patients under twenty years of age, and 50 to 60 microcuries were utilized in indicated adult cases. At least twenty-four hours were allowed for localization of the isotope. Areas to be scanned were selected either on the basis of x-ray changes or by probe counting over suspected bone areas. Scanning was performed with a Picker magnascanner equipped with a 3 × 2-in. thallium-activated sodium iodide crystal and a 19-hole, coarse-focus collimator (4). With an 80-kev window about strontium 85, single 0.51 Mev gamma, count rates over positive areas of the skeleton averaged 500 counts per minute above surrounding bone tissue. Satisfactory scans were made at a scanning speed of 16 to 20 cm. per minute with a count per minute range differential setting (4) of 10 per cent and a film density of 100. Appropriate markers were placed on the photoscans and, with lead overlays of these identifying marked areas, a roentgenogram was made for superimposition (Figs. 1 and 2).

#### COMMENT

Strontium 85 has a half-life of sixty-five days. It decays by electron capture to metastable Rb<sup>85</sup>,



Fig. 1. A. Bone lesion in radius secondary to metastatic carcinoma of breast.

B. Superimposed photoscans showing increased localization of Sr<sup>85</sup> in the damaged radius.



Fig. 2. A. Superimposed photoscans of humerus showing localization of Sr<sup>85</sup> at the fracture sites.

B. Roentgenogram showing traumatic fracture of surgical neck of humerus.

which emits a single gamma photon of 0.51 Mev and becomes stable Rb<sup>85</sup>. There are no beta or alpha emissions and hence the bone radiation dose is small. Of the administered dose, approximately 55 per cent is excreted by the fifth day (2). The remaining strontium 85 becomes permanently fixed in the skeleton. Correcting for 50 per cent excretion in the

first five days, one may estimate the total whole-body dose to a standard man at 0.326 rads, with a bone dose of approximately 2.28 rads (5).

The rather energetic 0.51 Mev gamma of strontium 85 presented no unusual collimation problems, as the shielding on the probe of the equipment utilized was adequate.

Preliminary work indicates that photoscanning of bone lesions is practical, desirable, and informative. Strontium-85 localization appears to occur only in areas of increased osteoblastic activity and is thereby an excellent means of evaluating this function of bone repair. Studies are in progress to assess bone scanning as a parameter of diagnosis and prognosis of skeleton lesions.

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<sup>1</sup> From the Radioisotope Laboratory, U. S. Naval Hospital, National Naval Medical Center, Bethesda, Md.

<sup>2</sup> Present address: McCollum-Pratt Institute, Johns Hopkins University, Baltimore, Md.

The views expressed are those of the authors and do not necessarily reflect those of the Naval Service at large.

<sup>3</sup> Millipore Filter Corporation, Bedford, Mass.



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# EDITORIAL

## The New Role of Radiology in the Medical Curriculum

Medical education is currently undergoing a phase of transition. Many of the traditional teaching methods and standard curricula are under active scrutiny and, in several schools, have given way to radical new approaches. The objectives of these modifications are directed toward more individualized, broader, liberal education of the student and keeping pace with the tremendously expanding volume of medical knowledge without lengthening (perhaps shortening) the total period of training.

In this light, it is of interest to compare the casual treatment of radiology in the medical curriculum of ten years ago with what is currently being offered in a number of teaching centers in the country. Our own experiences in the past five years with a new approach to the teaching of radiology to medical students has been most gratifying in the enthusiasm of the response of our students and faculty.

Our concept of the role of radiology in the undergraduate teaching program is that of a discipline in which the anatomy, normal and abnormal physiology, and pathology of the living patient may be subjected to intimate scrutiny and analysis to determine the status of his health or disease. Our undergraduate teaching objectives are to help the student develop an understanding of basic skills and technics and to acquire judgment to work within the limitations of his experience, to relate basic sciences to clinical practice, to teach the scientific approach, and, on an elective basis, to permit the student to acquire special knowledge and skills. We believe that the principles and applications of radiology are best taught in an integrated program closely related with the fundamental basic scientific disciplines. Under such a plan there is usually no requirement

for a large separate block of curriculum time for radiologic teaching.

To be truly effective, such orientation in radiology should be continuous throughout the educational period. Our program is perhaps worthy of description to illustrate this correlation with other disciplines.

In the first year, radiographic anatomy is presented in a correlative fashion with gross anatomy. Similarly, the physiology of the cardiorespiratory and gastrointestinal tracts is illustrated by cineradiography. The second-year course in pathology is supplemented by discussions of the radiographic manifestations corresponding to the gross and histologic organ pathology under study. Instruction in physical diagnosis is implemented by radiographic and cineradiographic demonstrations of normal and abnormal states. A further, relatively unexplored area of integrated teaching is the application of radiologic demonstration of the effects of pharmacologic agents. The third year provides an opportunity for students to receive instruction in phases of radiology which have not been covered in depth in the preceding two years. These include instruction in aspects of diagnostic radiology more intimately connected with clinical work, such as cardiovascular, neurologic, and orthopedic radiology. The third-year course also includes an introduction to radiotherapy, radiobiology, and radioisotopes. Radiation hazards are evaluated at this time. In both the third and fourth years, the students participate actively in clinicoradiologic conferences, with discussions of current cases. For the interested student, a six-week elective in radiology is offered in the fourth year. During this elective course, the student participates actively in the functions of the department rather than as an observer.

This optional program has proved to be the most sought-after elective in the curriculum.

The end-product of such an educational experience is not a neophyte radiologist, but rather a physician who has a better understanding of human anatomy, physiology, and its pathologic alterations, as well as a broad appreciation of the role of radiology in patient care.

The acceptance of this program is not difficult to understand when one considers the potency of radiology as a teaching discipline. The student finds easier correlation and retention of subject material with the visual images presented by the roentgen technic. Also, the broad scope of radiol-

ogy permits it to cross specialty lines to present the total pattern of the pathologic state. It frequently brings the student his first, and often only, contact with disease entities which are not covered in his other courses.

A program of this type requires that the Department of Radiology be staffed adequately to accommodate a teaching load of this magnitude. The program cannot be allowed to become static. To maintain its vitality, it should be re-evaluated and re-oriented periodically to permit its continued inclusion in the changing pattern of medical teaching.

THEODORE E. KEATS, M.D.  
GWILYM S. LODWICK, M.D.



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# RADIOLOGICAL SOCIETY OF NORTH AMERICA

## FORTY-SEVENTH ANNUAL MEETING: PRELIMINARY PROGRAM

Palmer House, Chicago, Illinois

Nov. 26-Dec. 1, 1961

### Sunday, November 26

PANEL DISCUSSION: 10:00 A.M.-12:00

CURRENT OPINIONS FROM THE  
AMERICAN COLLEGE OF RADIOLOGY  
ON PRINCIPLES OF ETHICS AND ECONOMICS

State Ballroom

Earl E. Barth, M.D., Chicago, Ill., Moderator  
Wallace D. Buchanan, M.D., South Bend, Ind.  
Wilbur Bailey, M.D., Los Angeles, Calif.  
Wendell G. Scott, M.D., St. Louis, Mo.  
L. Henry Garland, M.D., San Francisco, Calif.

### Monday, November 27

OPENING SESSION: 1:45-4:15 P.M.

Grand Ballroom

Call to Order. H. MILTON BERG, M.D., President.  
Greetings. ROBERT M. POTTER, M.D., President,  
Chicago Roentgen Society.

Philip J. Hodes, M.D., Philadelphia, Penna.  
First Vice-President, Presiding

President's Address. H. MILTON BERG, M.D., Bismarck, N. Dak.

The Organization of Therapeutic Radiology in Sweden. ELIS BERVEN, M.D., Stockholm, Sweden.

Introduction of Memorial Fund Lecturer. LEO G. RIGLER, M.D., Los Angeles, Calif.

Memorial Fund Lecture: Visual Search, Image Organization, and Reader Error in Roentgen Diagnosis; Studies of the Psycho-Physiology of Roentgen Image Perception. WILLIAM TUDDENHAM, M.D., Philadelphia, Penna.

Renal Angiography in the Differential Diagnosis of Unilateral Non-Functioning Kidney. OLLE OLSSON, M.D., Lund, Sweden.

Angiography of the Coronary Vessels. BJÖRN NORDENSTRÖM, M.D., C.-O. OVENFORS, M.D., and G. TÖRNELL, M.D., Stockholm, Sweden.

BUSINESS MEETING: 4:30 P.M.

Grand Ballroom

### Tuesday, November 28

DIAGNOSIS: 10:30 A.M.-12:30 P.M.

Grand Ballroom

John R. Hodgson, M.D., Rochester, Minn.  
Second Vice-President, Presiding

False Paradoxical Movement of the Left Ventricle Simulating Myocardial Aneurysm. THEODORE E. KEATS, M.D., and JACK M. MARTT, M.D., Columbia, Mo.

Roentgen Evaluation of Cardiac Competence. ROBERT S. ORMOND, M.D., and WILLIAM R. EYLER, M.D., Detroit, Mich.

Role of Renal Angiography in the Diagnosis of Hydro-nephrosis. OLLE OLSSON, M.D., Lund, Sweden.

Angiography of Tumors of the Extremities. ÅKE LINDBOM, M.D., Stockholm, Sweden.

Quantitation of Aortic Valvular Insufficiency by Catheter Thoracic Aortography. J. STAUFFER LEHMAN, M.D., JAMES J. BOYLE, JR., M.D., and JOSEPH N. DEBBAS, M.D., Philadelphia, Penna.

Valvular Calcifications; Comparison of Routine Film Studies, Fluoroscopy, Laminagraphy and Cine-fluorography in Relative Incidence of Positive Findings. J. H. WOODRUFF, JR., M.D., Torrance, Calif.

RADIOBIOLOGY: 10:30 A.M.-12:30 P.M.

State Room

G. M. McDonnell, M.D., Los Angeles, Calif., Chairman,  
Radiobiology Section of Program Committee, Presiding

Quantitative Assessment of Radiation Damage in a Mammalian Tumor Studied *in Vivo*. ROGER J. BERRY, M.D., and J. ROBERT ANDREWS, M.D., Bethesda, Md.

Radiation Breakage of Human Chromosomes *in Vivo* and *in Vitro*. RICHARD E. OTTOMAN, M.D., and AMOS NORMAN, Ph.D., Los Angeles, Calif.

DNA Synthesis as a Biologic Marker in Fractionated Radiation. FRANK R. HENDRICKSON, M.D., and JOHN W. CLARK, M.D., Chicago, Ill.

Oxygen Effect Factors of Human Skin. HERMAN D. SUIT, M.D., Houston, Texas.

Effect of Fractionation on Cataract Production in Rat Lens. GEORGE R. MERRIAM, JR., M.D., and ELIZABETH F. FOCHT, B. A., New York.

Chemical Protection Against Irradiation Effects on Growing Cartilage. L. YOUNG, M.D., Portsmouth, N. H., P. RUBIN, M.D., and G. CASARETT, Ph.D., Rochester, N. Y.

Dependence of Short-Term Mammalian Radiation Effects on Dose Rate. J. L. BATEMAN, M.D., and V. P. BOND, M.D., Ph.D., Upton, Long Island, N. Y.

Fertility of CF No. 1 Female Mice Irradiated with Fission Neutrons. HOWARD H. VOGEL, JR., Ph.D., and DONN L. JORDAN, B. S., Argonne, Ill.

Interstitial Irradiation Using Radioactive Microspheres. YOUNG SONG KIM, M.D., ANNETTE M. SORENSON, B.S., and LLOYD D. MACLEAN, M.D., Ph.D., St. Paul, Minn.

Fifteen-Minute Open Discussion.

#### DIAGNOSIS: 2:00-4:00 P.M.

##### Grand Ballroom

Herbert M. Stauffer, M.D., Philadelphia, Penna., Presiding<sup>1</sup>

Factors Determining Film Exposure in Cineradiography. J. A. CAMPBELL, M.D., E. C. KLATTE, M.D., ALICE MCCREA, M.S., and DONALD D. GRAY, R. T., Indianapolis, Ind.

Dosimetry on Cineradiography and other Specialized Radiographic Diagnostic Studies. M. PAUL CAPP, M.D., MADISON S. SPACH, M.D., and ROBERT J. REEVES, M.D., Durham, N. C.

A Cinefluorographic Study of the Peristalsis of the Duodenum. JOSEPH JORGENSEN, M.D., Ph.D., Minneapolis, Minn.

Cinefluorographic Investigation of Genitourinary Tract Function. (1) Combined Simultaneous and Synchronous Cinefluorography and Intravesical Manometry in the Evaluation of Neurogenic Bladder Function and Chronic Bladder Outlet Obstruction. THEODORE A. TRISTAN, M.D., JOHN J. MURPHY, M.D., and HARRY W. SCHOENBERG, M.D., with the technical assistance of Robert D. Epperson, B.Sc., Philadelphia, Penna.

Image Orthicon Fluoroscopy of a Twelve-Inch Field, and Direct Recording of the Monitor Image. R. BRIAN HOLMES, M.D., and D. J. WRIGHT, Ph.D., Toronto, Ontario, Canada.

Comparative Usefulness of 5" and 9" Image Amplifiers in the Practice of Teleroentgendiagnosis. GUY DUCKETT, M.D., and ALBERT JUTRAS, M.D., Montreal, Quebec, Canada.

Telex-Tape-Kinescopy and Cine-Radiography—Comparison of Two Methods of Recording Fluoroscopy. BERTRAM R. GIRDANY, M.D., and EDWIN S. GAITHER, M.D., Pittsburgh, Penna.

Problems Associated with Installation, Operation, and Maintenance of Image Orthicon Radiographic Equipment. THEODORE F. HILBISH, M.D., and JOSEPH M. MOREL, A.B., R. T., Bethesda, Md.

#### THERAPY: 2:00-4:00 P.M.

##### State Room

Jesshill Love, M.D., Santa Barbara, Calif., Chairman, Therapy Section of Program Committee, Presiding

Combined Radiotherapy and Chemotherapy in the Treatment of Vascular Tumors. RUTH J. GUTTMANN, M.D., FRED HERTER, M.D., and GEORGE HYMAN, M.D., New York.

Place of Radiation Therapy in the Management of Carcinoma of the Rectum and Rectosigmoid Colon. C. C. WANG, M.D., and M. D. SCHULZ, M.D., Boston, Mass.

Ten-Minute Floor Discussion of First Two Papers.

Treatment of Carcinoma of the Endometrium. JOSE M. SALA, M.D., Columbia, Mo., and JUAN A. DEL REGATO, M.D., Colorado Springs, Colo.

Appraisal of Radiographic Localization Techniques for Uterine Radium. ELIZABETH F. FOCHT, B.A., and HARRY W. BURNETT, JR., M.D., New York.

Ten-Minute Question Period.

Use of a Resilient Material for Intra-oral Radium Mold, Featuring an Afterloading Technic. MELVIN L. GRIEM, M.D., and GEORGE W. BARNHART, Chicago.

Interstitial Implantation with Removable Nylon Tubes and Afterloading with Iridium-192 Seeds. ULRICH K. HENSCHKE, M.D., Ph.D., and BASIL S. HILARIS, M.D., New York.

Question Period for Last Two Papers.

#### BUSINESS MEETING: 4:30 P.M.

##### Grand Ballroom

#### ANNUAL ORATION: 8:00 P.M.

##### Grand Ballroom

Annual Oration in honor of the Memory of Donald S. Childs, M.D.: The Education of the Radiologist—Thence and Whence. LAURENCE L. ROBBINS, M.D., Boston, Mass.

#### Wednesday, November 29

#### DIAGNOSIS: 10:30 A.M.-12:30 P.M.

##### Grand Ballroom

George B. Cahill, M.D., Chicago, Ill., Chairman, Local Executive Committee, Presiding

A Comparison of Intravenous Urography, Urine Radiography, and Other Renal Tests. RUSSELL WIGH, M.D., BURTON P. GRANT, M.D., and HUBERT F. ANTHONY, JR., M.D., Augusta, Ga.

Intravenous Pyelography in Renal Insufficiency in Children. D. W. MACEWAN, M.D., J. S. DUNBAR, M.D., and M. B. NOGRADY, M.D., Montreal, Quebec.

Angiography in the Diagnosis of Bladder Tumors. ERIK BOIJSEN, M.D., Lund, Sweden.

Angiographic Study of the Renal Area in Hypertension. WILLIAM R. EYLER, M.D., MAX D. CLARK, M.D., JAMES A. GARMAN, M.D., ROGER L. RIAN, M.D., and DAN E. MEININGER, M.D., Detroit, Mich.

<sup>1</sup> At the request of the Program Committee, Dr. Stauffer was kind enough to arrange this afternoon's program.

Renal Scanning Using Stop Flow. JORGEN SCHLEGEL, M.D., JOSEPH L. IZENSTARK, M.D., and CHARLES M. NICE, JR., M.D., Ph.D., New Orleans, La.

Value of the Prone Position in Intravenous Urography. MILTON ELKIN, M.D., New York.

Discussion of above papers by OLLE OLSSON, M.D., Lund, Sweden.

#### NUCLEAR MEDICINE: 10:30 A.M.-12:30 P.M.

##### State Room

John P. Storaasli, M.D., Cleveland, Ohio, Presiding<sup>2</sup>

Thyroid Uptake Studies Using Very Small Doses of <sup>131</sup>I. JOHN R. CAMERON, Ph.D., and DOUGLAS B. BELL, M.D., Madison, Wisc.

Evaluation of Portal Circulation by Means of Percutaneous Splenic Isotope Injection. ROBERT H. GREENLAW, M.D., and SEYMOUR I. SCHWARTZ, M.D., Rochester, N. Y.

Ca<sup>47</sup> and Sr<sup>88</sup> Kinetic Studies as a Guide to Isotope Therapy. O. H. PEARSON, M.D., S. SOLARIC, M.D., and J. P. STORAASLI, M.D., Cleveland, Ohio.

Discussion Period.

Utilization of <sup>131</sup>I Hippuran as an Agent for Surveying Patients with Hypertension. I. MESCHAN, M.D., JOSEPH WHITLEY, M.D., RICHARD WITCOFSKI, M.S., and JAMES QUINN, III, M.D., Winston-Salem, N. C.

Value of the Scintiscan as an Aid in Diagnosis of Liver Disease. FRIEDA FELDMAN, M.D., CARL J. COLLICA, B.S., and SIDNEY RUBENFELD, M.D., New York.

Information Limitations of Radioisotope Scanning. J. H. CHRISTIE, M.D., and W. J. MACINTYRE, Ph.D., Cleveland, Ohio.

Discussion Period.

#### DIAGNOSIS: 2:00-4:00 P.M.

##### Grand Ballroom

Robert M. Potter, M.D., Chicago, Ill., Chairman, Local Scientific Sessions Committee, Presiding

Intracerebral Hemorrhage Masquerading as a Neoplasm: Difficult Neuroradiologic Problem. HILLIER L. BAKER, JR., M.D., Rochester, Minn.

Total Vertebral-Basilar Arteriography via Transbrachial Catheterization. MAURICE TATELMAN, M.D., and SHEILA SHEEHAN, M.D., Detroit, Mich.

The Value of Angiography in Head Trauma. EUGENE LESLIE, M.D., BERNARD SMITH, M.D., and JOHN ZOLL, M.D., Buffalo, N. Y.

Hepatolienography Ten Years Later. SYDNEY F. THOMAS, M.D., Palo Alto, Calif.

Percutaneous Transhepatic Cholangiography in Obstructive Biliary Tract Disease. JOHN A. EVANS, M.D., Z. MUJAHED, M.D., and B. THORBJARNARSON, M.D., New York.

Venography of the Inferior Vena Cava. ÅKE LINDBOM, M.D., Stockholm, Sweden.

Open Discussion of Above Papers.

<sup>2</sup>At the request of the Program Committee, Dr. Storaasli was kind enough to arrange this program on Nuclear Medicine.

#### THERAPY: 2:00-4:00 P.M.

##### Red Lacquer Room

Victor A. Marcial, M.D., Rio Piedras, Puerto Rico Presiding

Radiotherapy for Carcinoma of the Nasopharynx. MARTHA C. SCHMIDT, M.D., Buffalo, N. Y.

Five-Minute Open Discussion.

Radiation Therapy in the Management of Cancer of the Tonsillar Area. W. D. RIDER, M.D., Toronto, Ontario, Canada.

Five-Minute Open Discussion.

Panel Discussion.

Combined Radiation Therapy and Surgery for Advanced Carcinoma of the Oral Cavity. FRANZ BUSCHKE, M.D., and MAURICE GALANTE, M.D., San Francisco, Calif.

Correlation of Clinical Results with Explicit Calculations of Isodose Distributions in Interstitial Implantations of the Squamous-Cell Carcinomas of the Anterior Two-Thirds of the Tongue and Floor of the Mouth. GILBERT H. FLETCHER, M.D., Houston, Texas.

Method of Analysis for Evaluation of Treatment in Oropharynx Cancers. ELEANOR J. MACDONALD, A.B., Houston, Texas.

Ten-Minute Open Discussion Directed by GILBERT H. FLETCHER, M.D., Houston, Texas.

A Simple Method of Indexing and Filing of Radiation Therapy Records and of Patient Follow-up. MILFORD D. SCHULZ, M.D., and CHIU-CHEN WANG, M.D., Boston, Mass.

Open Question Period.

#### WORK-IN-PROGRESS IN PHYSICS: 2:00-4:30 P.M.

##### State Room

Warren K. Sinclair, Ph.D., Chicago, Ill., Chairman, Physics Committee, Presiding

This program is arranged only a few weeks before the meeting, and details are therefore not now available.

#### MOVIE: 4:30 to 5:25 P.M.

Introduction. E. RICHARD KING, M.D., Richmond, Va.

Movie (Produced by U. S. Navy): Radiation Protection in Nuclear Medicine.

Discussion by JOHN D. REEVES, M.D., Gainesville, Fla.

#### Thursday, November 30

#### DIAGNOSIS: 10:30 A.M.-12:30 P.M.

##### Grand Ballroom

Robert B. Lewis, M.D., Chicago, Ill., Member, Local Scientific Sessions Committee, Presiding

Radiologic Features of Lacrimal Gland Tumors. THOMAS H. NEWTON, M.D., San Francisco, Calif.

Roentgen Findings in Obstructed Diaphragmatic Hernia. ETHYL S. BLATT, M.D., JEROME F. WIOT, M.D., HAROLD J. SCHNEIDER, M.D., and BENJAMIN FELSON, M.D., Cincinnati, Ohio.



Roentgen Technics in the Diagnosis and Localization of Pheochromocytoma. HENRY P. PENDERGRASS, M.D., THEODORE A. TRISTAN, M.D., WILLIAM S. BLAKEMORE, M.D., ALFRED M. SELLERS, M.D., PETER J. JANNETTA, M.D., and JOHN J. MURPHY, M.D., Boston, Mass.

Growth Rate as an Aid in Differentiating Benign from Malignant Lesions. M. H. NATHAN, M.D., and V. P. COLLINS, M.D., Houston, Texas

Metaphyseal Dysplasia Due to Lead Poisoning in Children. CHARLES N. PEASE, M.D., Chicago, Ill., and GWENDOLYN G. NEWTON, M.D., Barrington, Ill.

The Tarsus: Basic Relationship and Motion in the Adult. JOHN H. FEIST, M.D., and HENRY J. MANKIN, M.D., Pittsburgh, Penna.

Early Roentgen Diagnosis of Tuberculosis of the Hip in Children. JOSEPH M. WINSTON, M.D., EUGENE P. PENDERGRASS, M.D., and JAMES HEWSON, M.D., Philadelphia, Penna.

Advantages of Three-Phase Spot-Film Radiography. JOHN C. WATSON, R. T., AARON S. WEINSTEIN, M.D., and RICHARD H. GREENSPAN, M.D., New Haven, Conn.

#### Therapy: 10:30 A.M.-12:30 P.M.

##### Red Lacquer Room

George J. Cooper, M.D., Charlottesville, Va.,  
Third Vice-President, Presiding

The Use of Megavoltage Therapy in the Treatment of Cancer. End-Results. JUSTIN J. STEIN, M.D.; RICHARD E. OTTOMAN, M.D., EDWARD A. LANGDON, M.D., and WILLIAM A. GORE, M.D., Los Angeles.  
Five-Minute Open Discussion.

A Preliminary Report on the Treatment of Cancer of the Cervix by a Rotation Technic with Cobalt-60 Teletherapy. GEORGE P. KOECK, M.D., LILLIAN E. JACOBSON, M.A., and WILLIAM R. HILLSINGER, B.S., Newark, N. J.

Five-Minute Question Period.

Radiotherapy of Carcinoma of the Skin Overlying Cartilage. J. A. DEL REGATO, M.D., and MARIO VUKSANOVIC, M.D., Colorado Springs, Colo.

Five-Minute Question Period.

Carcinoma of the Penis, Therapeutic Problems. VICTOR A. MARCIAL, M.D., Rio Pedras, Puerto Rico.

Five-Minute Open Discussion.

Movie: Operating Room Technics of Radium Implants: Parotid and Vagina. FERNANDO G. BLOEDORN, M.D., CARLO A. CUCCIA, M.D., RAUL MERCADO, JR., M.D., and MORRIS J. WIZENBERG, M.D., Baltimore, Md.

Open Discussion.

#### Physics: 10:30 A.M. to 12:30 P.M.

##### State Room

Special Session of Invited Papers in Honor of the  
70th Birthday of Doctor Gioacchino Failla

Lauriston S. Taylor, D.Sc., National Bureau of Standards,  
Presiding

Introductory Remarks. LAURISTON S. TAYLOR, D.Sc.,  
Washington, D. C.

Medical Radiation Physics in the United States. EDITH H. QUMBY, D.Sc., New York.

Distribution of Radiation Energy in the Cell. HARALD H. ROSSI, Ph.D., New York.

Radiologic Life-Shortening, Senescence, and Carcinogenesis. P. S. HENSHAW, Ph.D., Washington, D. C.  
A Study of Factors in Radiation Effects in Tumor Cells. TITUS C. EVANS, Ph.D., Iowa City, Iowa.

Retention of Radium in Man from Twenty-one to Twenty-nine Years After Intravenous Administration. L. D. MARINELLI, Ph.D., Argonne, Ill.

Ceremonies in Honor of Dr. Failla. H. MILTON BERG, M.D.

#### DIAGNOSIS: 2:00-4:00 P.M.

##### Grand Ballroom

Stanley M. Wyman, M.D., Boston, Mass., Consultant to  
Program Committee, Presiding

Polarized Light Animations of Atomic and Congenital Heart Slides. L. G. IDSTROM, M.D., Minneapolis, Minn.

Radiological Evidence of Bone Growth in Homotransplanted Rat Legs. JUSTIN V. SCHWIND, M.D., Santa Barbara, Calif.

Stereoscopic Televised Fluoroscopy. HERBERT M. STAUFFER, M.D., GEORGE C. HENNY, M.D., and ARCHIE W. BLACKSTONE, E.E., Philadelphia, Penna.

Arteriography of the Stomach and Colon (A Comparative Study of *in Vivo* Injections, Specimen Injections, and Micro-angiography of Specimens). WILLIAM H. MCALISTER, M.D., ALEXANDER R. MARGULIS, M.D., and HARLAN SPJUT, M.D., St. Louis, Mo.

A Form of Alveolar-Cell Carcinoma of the Lung with a Good Prognosis. RICHARD BELGRAD, M.D., C. ALLEN GOOD, M.D., and LEWIS B. WOOLNER, M.D., Rochester, Minn.

Gastric Intussusceptions. M. H. POPPEL, M.D., New York.

Calcified Atherosclerosis as an Aid in Differential Diagnosis of the Gastric Lesion. JOHN P. FOTOULOS, M.D., and ARTHUR R. CRAMPTON, M.D., Evanston, Ill.

Closed Chest Cardiac Resuscitation. CHARLES T. DOTTER, M.D., Portland, Ore.

#### Therapy: 2:00-4:00 P.M.

##### Red Lacquer Room

J. Ernest Breed, M.D., Chicago, Ill.  
Member of Local Scientific Session Committee, Presiding

Radical Radiotherapy of Regionally Localized Hodgkin's Disease. HENRY S. KAPLAN, M.D., Palo Alto, Calif.

Roentgen Therapy of Primary Gastrointestinal Lymphoma. JAMES C. COOK, M.D., and DAVID P. CORBETT, M.D., Detroit, Mich.

Ten-Minute Question and Discussion Period of First Two Papers.

Significance of Scoliosis in Post-Irradiated Wilms' Tumor and Neuroblastoma. P. RUBIN, M.D., ROBB DUTHIE, M.D., and L. YOUNG, M.D., Rochester, N. Y.

Results of Long-Term Follow-up of Radiation Treated Wilms' Tumor in Children. JEROME M. VAETH, M.D., SEYMOUR LEVITT, M.D., MALCOLM D. JONES, M.D., and CHARLES HOLTGRETER, M.D., San Francisco, Calif.

Ten-Minute Discussion Period of Last Two Papers.

Carcinoma of the Ocular Conjunctiva: Its Treatment with Roentgen Rays. JUAN FAYOS, M.D., Ann Arbor, Mich., and ORLISS WILDERMUTH, M.D., Seattle, Wash.

Lenticular Changes Associated with Beta Irradiation of the Eye and Their Significance. C. I. THOMAS, M.D., J. P. STORAASLI, M.D., and H. L. FRIEDEL, M.D., Cleveland, Ohio.

Discussion of Last Two Papers by GEORGE R. MERIAM, JR., M.D., New York.

#### PHYSICS: 2:00 to 4:00 P.M.

##### State Room

E. W. Webster, Ph.D., Bedford, Mass.,  
Presiding

Calibration of the Absorbed Dose Produced in Water by Betatron Electrons with the Benzoic Acid Dosimeter. N. F. BARR, Ph.D., M. B. STARK, B.S., and J. S. LAUGHLIN, Ph.D., New York.

A Lithium Fluoride Thermoluminescent Radiation Dosimeter. JOHN R. CAMERON, Ph.D., and GORDON S. KENNEY, B.S., Madison, Wisc.

Experimental Determination of Absorbed Dose from X-rays Near the Interface of Soft Tissue and Other Material. CATHARINE L. WINGATE, Ph.D., New York, W. GROSS, Ph.D., New York, and G. FAILLA, D.Sc., Argonne, Ill.

Computation of a Comprehensive Implant Dosimetry System. W. SILER, M.S., E. HOLODNY, B.S., H. LECHTMAN, A.B., and J. S. LAUGHLIN, Ph.D., New York.

Explicit Calculations by a Digital Computer of Isodose Distributions in Interstitial Implantations. MARILYN STOVALL, B.A., and ROBERT J. SHALEK, Ph.D., Houston, Texas.

A New Ionization Chamber System for Regularly Checking the Output of X-ray Therapy Machines. LEONARD STANTON, M.S., Philadelphia, Penna.

#### BUSINESS MEETING: 4:30 P.M.

##### Grand Ballroom

#### SOCIAL HOUR: 6:30 P.M.

##### State Room

#### DINNER DANCE: 7:30 P.M.

##### Red Lacquer Room

Presentation of the Gold Metal of the Society.  
Introduction of New Officers.  
Presentation of the Pfahler Gavel.

#### Friday, December 1

#### WORKS-IN-PROGRESS IN DIAGNOSIS: 10:30 A.M.-12:30 P.M.

##### Grand Ballroom

Ted F. Leigh, M.D., Atlanta, Ga., Chairman,  
Diagnostic Section of Program Committee, Presiding

Clinical Evaluation of a New Bronchographic Contrast Medium: Hytrast. ROBERT MOUNTS, M.D., and WILLIAM MOLNAR, M.D., Columbus, Ohio.

Bronchial Arteriography. JOHN R. WILLIAMS, M.D., and FREDERICK J. BONTE, M.D., Dallas, Texas.

The Injection of Plastic Material into the Coronary Arteries as a Means of Creating Models of the Coronary Anatomy. JAMES F. MARTIN, M.D., GEORGE C. BARRETT, M.D., and I. MESCHAN, M.D., Winston-Salem, N. C.

Determination of Radiation Dose During Fluoroscopic Procedures with the Aid of the Fluoroscopic Simulator. W. B. MILLER, JR., B.S., R. H. ROHRER, Ph.D., and H. S. WEENS, M.D., Atlanta, Ga.

Some Further Pertinent Considerations Regarding the Comparative Toxicity of Contrast Materials for the Dog Kidney. ELLIOTT C. LASSER, M.D., SIL H. LEE, M.D., BERNARD FISHER, M.D., and EDWIN FISHER, M.D., Pittsburgh, Penna.

Brachiocephalic Angiography in Atheromatous Disease. COLVIN H. AGNEW, M.D., KARL YOUNGSTROM, M.D., C. POSER, M.D., and C. HARDIN, M.D., Kansas City, Kans.

Animation of Serial Roentgenograms for 16-mm. Projection. RUSSELL WIGH, M.D., and WINFORD H. POOL, JR., M.D., Augusta, Ga.

Transhepatic Portal Venography: A New Method of Portal-System Visualization. RICHARD H. GREENSPAN, M.D., WARREN D. WIDMANN, M.D., JULIAN H. CAPPS, M.D., MASSIMO CALABRESI, M.D., and HAROLD O. CONN, M.D., New Haven, Conn.

A Sign of Intestinal Perforation. PAUL A. MORI, M.D., Jacksonville, Fla.

The Use of Skull X-Rays as a Screening Procedure in Patients with Psychiatric Disorders. SIDNEY P. TRAUB, M.D., Saskatoon, Saskatchewan.

"Senile" Osteoporosis. J. GERSHON-COHEN, M.D., J. F. McCLENDON, Ph.D., and JENIFER JOWSEY, Ph.D., Philadelphia, Penna.

Larynx Examination by Spot Films. L. JEROME LEWIS, M.D., San Francisco, Calif.

#### WORKS-IN-PROGRESS IN THERAPY: 10:30 A.M.-12:30 P.M.

##### State Room

Jesshill Love, M.D., Santa Barbara, Calif., Chairman,  
Therapy Section of the Program Committee, Presiding

A Practical Multiple Beam Shaper for Cesium-137 Teletherapy Unit. ROBERT S. LANDAUER, Ph.D., Chicago, Ill.

Study of the Effect of Lowering Temperature to Give Skin-Sparing and Increase Depth Dose with Conventional X-Rays (300 kv). EDWIN J. LIEBNER, M.D., Chicago, Ill.

- High Energy Radiography ( $\text{Co}^{60}$  and  $\text{Ca}^{137}$ ) for Tumor Localization and Treatment Planning. ELLIOTT SPRINGER, M.D., Duarte, Calif.
- Post-Irradiation Hyperlipemia. MAURICE L. BOGDONOFF, M.D., Chicago, Ill.
- Studies of Bone Changes in the Rat Resulting from 250-kv Radiation Compared with Cobalt-60 Radiation. M. N. LOUGHEED, M.D., Montreal, Quebec.
- Re-Evaluation of the Management of Teeth in Oral Cavity Irradiation After Ten Years. ORLISS WILDERMUTH, M.D., Seattle, Wash.
- Combined Irradiation and Chemotherapy in Ovarian Carcinoma. EMANUEL E. SCHWARTZ, M.D., Philadelphia, Penna.
- Pelvic Pneumography in Carcinoma of the Cervix. JOSE M. SALA, M.D., Columbia, Mo.
- Isotopic Renogram in Evaluation of the Urinary Tract During and After Radiation Therapy to the Pelvis and/or Abdomen. DAMON D. BLAKE, M.D., Winston-Salem, N. C.
- A Redefinition of Point "A" in Radium Applications for Carcinoma of the Cervix. ALAN C. SCHEER, M.D., New York.
- The Use of Radioactive Calcium 47 in the Evaluation of Bone Healing in Metastatic Disease. LUTHER W. BRADY, M.D., MILLARD N. CROLL, M.D., LEONARD STANTON, M.S., DAVID HYMAN, B.A., and STEVEN RUBINS, Philadelphia, Penna.
- The Effect of the Administration of Lactobacilli on Survival of Irradiated Rats. EUGENE L. SAENGER, M.D., JOSE CARINGAL, M.D., JAMES G. KEREIAKES, Ph.D., Cincinnati, Ohio.
- Surface Moulage-Telecobalt Therapy Supplanting Radium Molds: Dosimetry, Technic, and Results. COMDR. FREDERICK W. GEORGE, MC, USN, San Diego, Calif.



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## REFRESHER COURSES: POSTGRADUATE INSTRUCTION

The 1961 Refresher Course Series will be presented during the Forty-seventh Annual Meeting of the Radiological Society of North America at The Palmer House, Chicago, Ill. Registration for the meeting will begin at 1:00 P.M., Saturday, November 25. On Sunday, November 26, the registration desk will be open at 9:00 A.M., and Monday through Friday at 8:00 A.M. *Please register early.* The courses will start at 2:00 P.M., Sunday, with the Combined Radiotherapy-Chemotherapy Symposium in the Treatment of Cancer. This will be followed by a course on the Introduction to Cineradiography beginning at 4:30 P.M., and the Film Interpretation Session at 7:30 P.M.

On Monday, November 27, there will be a series of courses beginning at 8:30 A.M. and continuing until 10:00 A.M., with a second series of courses from 10:30 to 12:00 A.M. For the remainder of the week the Refresher Course period will be 8:30 to 10:00 A.M. No other meetings will be scheduled for these hours.

Attendance is limited to the medical profession, including graduate students and residents in radiology, radiation physicists, radiobiologists, chemists, *medical students certified by the deans of their respective medical schools*, and others closely allied with the science of radiology. *Residents, interns, and medical students may be limited to courses being presented in the Red Lacquer Room and the Grand Ball Room.*

A registration fee of \$25, which includes the refresher course fee, must be paid by all nonmembers of the Radiological Society of North America at the time of registration. The exceptions are guest speakers, guest instructors, scientific exhibitors,

residents, or fellows in radiology, *medical students*, trainees in physics, and officers in the Armed Forces of the United States on temporary duty away from their practice. All must register at the registration desk. Payment of the registration fee by nonmembers is *not* to accompany the request for tickets, but is to be paid at the time of registration. All refresher course tickets will be held at the registration desk in The Palmer House. Please call for them there. Positive identification will be required from nonmembers and guests for admission to the Refresher Courses. If you cannot use the tickets you have reserved, please notify the Chairman of the Refresher Course Committee.

Admission to the courses will be by presentation of the registration badge and a ticket for the desired course, with the exception of Courses Nos. 1, 2, and 3 on Sunday. Admission to these three courses will be by badge only. No ticket is required.

Read the description of the courses, noting particularly the days on which they are to be given, and make your selection. Turn to the colored insert, and indicate thereon your first, second, and third choice for the day, and mail the request promptly. The number attending many courses is limited by the capacity of the rooms, and requests for tickets will be honored in the order in which they are received. You will be notified regarding your selection of courses.

We would appreciate suggestions for future courses, as well as new instructors for some of the present ones. Please put your suggestions on a card and leave it at the registration desk, or mail it directly to the Refresher Course Chairman.

### Course No. 1: Sunday, 2:00-4:00 P.M.

#### Radiotherapy-Chemotherapy Symposium

JUSTIN J. STEIN, M.D., Moderator, Los Angeles, Calif.  
OSCAR CREECH, JR., M.D., New Orleans, La.  
LEON O. JACOBSON, M.D., Chicago, Ill.  
GILBERT H. FLETCHER, M.D., Houston, Texas  
JAMES J. NICKSON, M.D., New York, N. Y.

The purpose of this Symposium is to give a critical review of the chemotherapeutic drugs which are available for the treatment of cancer and the indications for their use. The toxicity and complications resulting from their use will be presented. The extent of participation of the radiation therapist in any combined therapy program will be discussed as well as the potentiation of radiotherapy by the use of supplemental drugs. This subject is a most timely one and should be of interest to everyone who is treating patients with cancer.

### Course No. 2: Sunday, 4:30-5:30 P.M.

#### Introduction to Cineradiography

H. M. STAUFFER, M.D., Moderator, Philadelphia, Penna.  
M. S. POTSAID, M.D., Boston, Mass.  
E. W. WEBSTER, Ph.D., Boston, Mass.

The benefits and advantages of cine-recorded fluoroscopy in both routine and special procedures will be presented. Pertinent basic concepts of the physiology and psychology of perception as applied to cineradiography will be reviewed. Technological considerations relating to film speeds, optical systems, and patient dose will be discussed. Methods of clinical application will be reviewed. Some of the current trends and future outlook of special cineradiographic techniques (*e.g.*, stereo-cineradiography and simultaneous fluoroendoscopy) will be briefly explored. It is hoped that this introductory course

will make the cineradiographic portion of the main program and the related refresher courses more fruitful for those not familiar with these technics.

### Course No. 3: Sunday, 7:30-9:30 P.M.

#### Film Interpretation Session

TED F. LEIGH, M.D., Moderator, Atlanta, Ga.  
LOIS C. COLLINS, M.D., Houston, Texas  
JOHN W. HOPE, M.D., Philadelphia, Penna.  
ROBERT E. WISE, M.D., Boston, Mass.  
WILLIAM T. MESZAROS, M.D., Chicago, Ill.

Cases for this refresher course have been selected primarily on the basis of interest, discussion, and differential diagnosis. They will be diversified as to the region of the body and length of discussion. Selected radiographs will be available on Sunday afternoon for a review by the membership.

### Course No. 4: Monday, 8:30-10:00 A.M.

#### The Small Intestine

RICHARD H. MARSHAK, M.D., New York, N. Y.

##### Part I

1. Technic, including a discussion of the various barium preparations
2. Concepts of small intestinal patterns
3. The Malabsorption syndrome. Sprue, lymphosarcoma, and Whipple's disease
4. Interpretation of functional changes
5. Barium studies in small intestine obstruction

##### Part II

1. Regional enteritis
2. Infarction of the small bowel
3. Tumors
4. Miscellaneous disorders including scleroderma, amyloidosis, and allergy

(This course continued Tuesday, Course No. 34)

### Course No. 5: Monday, 8:30-10:00 A.M.

#### Radiology of the Larynx and Pharynx

ARNOLD L. BACHMAN, M.D., New York, N. Y.

This course includes radiographic anatomy and physiology of the larynx, radiology of laryngeal paralysis, radiology of normal and abnormal swallowing patterns, tumors of the larynx and laryngopharyngeal tumors. In addition, certain benign conditions will be discussed, including foreign bodies of the cervical esophagus, cricopharyngeal spasm, and radiology of adenoids.

(This course continued Tuesday, Course No. 35)

### Course No. 6: Monday, 8:30-10:00 A.M.

#### Metabolic and Endocrine Diseases Involving the Skeletal System

HOWARD L. STEINBACH, M.D., San Francisco, Calif.

The major endocrine and metabolic factors affecting growth and maturation, and some recent concepts of the dynamic aspects of bone composition,

physiology, and pathology, will be discussed. To be considered are the radiologic aspects of the more common metabolic diseases such as osteoporosis and osteomalacia and Paget's disease, and the unusual manifestations of these conditions.

The second part of the discussion will deal with endocrine abnormalities producing skeletal alterations, recognizable by roentgenographic methods.

(This course continued Tuesday, Course No. 36)

### Course No. 7: Monday, 8:30-10:00 A.M.

#### Radiology of Congenital Heart Disease

JOHN A. CAMPBELL, M.D., Indianapolis, Ind.  
EUGENE C. KLATTE, M.D., Indianapolis, Ind.

The advent of successful open-heart surgery has changed the importance of roentgen diagnosis of congenital heart disease from a matter of academic interest to one of practical necessity. The roentgenologist serves several key functions in the diagnosis of the lesions. It is frequently his original fluoroscopic and plain film interpretations which lead to the recognition of these malformations, and distinguish those requiring more specialized diagnostic studies. As a member of the hospital cardiology team, the radiologist provides an indispensable service by performing selective cardioangiographic procedures which yield precise information about the altered morphology and hemodynamics.

The course will present the plain film and cardioangiographic diagnosis of the common types of congenital heart disease. Cineradiographic studies will be used to illustrate the pathological anatomy and physiology of the different conditions. Differential diagnosis will be emphasized.

##### Period I

1. Basic considerations in roentgen diagnosis
2. Patent ductus arteriosus
3. Ventricular septal defect
4. Atrial septal defect
5. Anomalous pulmonary venous return

##### Period II

1. Coarctation of aorta
2. Fibroelastosis and myocardial disease
3. Pulmonary stenosis
4. Tetralogy of Fallot
5. Tricuspid atresia
6. Truncus arteriosus
7. Transposition of great vessels
8. Miscellaneous

(This course continued Tuesday, Course No. 27)

### Course No. 8: Monday, 8:30-10:00 A.M.

#### Aorto-arteriography in the Management of Atherosclerosis of the Aorta, Iliac and Femoropopliteal Arteries

STANLEY M. ROGOFF, M.D., Rochester, N. Y.  
JAMES A. DeWEESE, M.D., Rochester, N. Y.

Various technics of arteriography for examination of atherosclerotic disease of the abdomen, pelvis, and



legs will be discussed. Case presentations will highlight the applications and diagnostic features of aortograms and arteriograms, including their implications in surgical management.

**Course No. 9: Monday, 8:30-10:00 A.M.**

**Treatment of Cancer of the Larynx**

**J. A. DEL REGATO, M.D., Colorado Springs, Colo.**

Surgery and radiotherapy have definite indications in the treatment of cancer of the larynx. Whereas radiotherapy has the advantage of being conservative, it does offer, in addition, excellent possibility of control of the disease in its earlier stages. Site of origin, extent of the disease, and character of the tumor, as well as the presence or absence of surgical metastases, may influence the primary choice of treatment.

**Course No. 10: Monday, 8:30-10:00 A.M.**

**Treatment Planning: Conventional Energy X-Rays**

**A. RAVENTOS, M.D., Philadelphia, Penna.**  
**J. HALE, Ph.D., Philadelphia, Penna.**

X-ray therapy equipment operating at 250 kvp or less is capable of producing quite satisfactory dosage distributions for the treatment of many lesions located deep within the body, as well as of practically all superficially placed lesions. Obtaining the optimum dosage distribution with conventional therapy equipment often requires careful treatment planning, based upon a good practical knowledge of the physical principles involved.

The basic principles of treatment planning will be discussed from both the physical and clinical standpoints, with examples of the use of very low-energy, intermediate, and 250-kvp x-ray beams. Some of the methods that have proved useful for portal selection, localization, and beam direction will be illustrated.

**Course No. 11: Monday, 8:30-10:00 A.M.**

**Therapeutic Applications of Radioactive Isotopes**

**E. R. KING, M.D., Richmond, Va.**

In the early days of the evaluation of the medical uses of radioisotopes, a great hope was placed in the possible treatment of cancer by this form of radiation. Several years experience, however, has proved that the therapeutic applications of radioisotopes are limited, particularly in reference to cancer. This statement does not apply to radioisotopes used in brachytherapy and teletherapy, nor does the discussion to be given in this course concern these more specialized applications.

Routine uses of radioisotopes may be listed under three categories: (1) the treatment of hematological disorders, (2) the treatment of hyperthyroidism and certain carcinomas of the thyroid, and (3) the treat-

ment of effusions complicating malignant diseases.

In certain instances, studies have been made, and are still under way, which investigate the uses of newer isotopes in treating cancer. This discussion will cover the routine uses in some detail, with a brief discussion of some new approaches in radioisotope therapy.

**Course No. 12: Monday, 8:30-10:00 A.M.**

**History and Development of Radium Applicators and Systems of Dosimetry**

**ELIZABETH F. FOCHT, B.A., New York, N. Y.**

In the early 1900's radium therapy began in this country with the use of a few milligrams of radium in a small glass tube. Ingenious technics of encapsulating the element and the "emanation" finally made possible its widespread practical use. Concurrently, tentative explorations into dosimetry grew to clinically applicable systems.

Using this double framework, we shall trace the development of the principles of dosimetry for internal gamma-emitting discrete sources up to 1961. The unifying aspects of distribution and dosage calculation will be covered for all gamma isotopes, and references arranged to summarize the field.

This course will be integrated as to content with Courses No. 32 and No. 42.

**Course No. 13: Monday, 8:30-10:00 A.M.**

**Radiobiology for Radiologists**

**E. L. SAENGER, M.D., Cincinnati, Ohio**

This course will present a brief review of the concepts of radiobiology which are of importance in radiation protection and therapy. The categories to be discussed are as follows:

1. Physical and chemical effects
2. Cellular effects
3. Biochemical effects
4. Radiosensitivity of various tissues
5. Modification of radiation reactors
6. Dose-time relationships
7. Neoplasia following irradiation

**Course No. 14: Monday, 8:30-10:00 A.M.**

**Fluoroscopy: Physics, Electronics, and Physiology**

**E. W. WEBSTER, Ph.D., Boston, Mass.**

The physical and physiological principles involved in fluoroscopy will be reviewed, with emphasis on the performance of the eye, quantitative aspects of radiation absorption and scattering in soft tissue, and fluorescent detectors, light production, light utilization, and detail perception. The advantages, methods, and basic physical limitations of image intensification will be discussed with special reference to quantum noise, the use of electronic contrast

# PLAN OF PRESENTATION

SUNDAY, Nov. 26: 2:00-4:00 P.M.	MONDAY, Nov. 27: 8:30-10:00 A.M.	MONDAY, Nov. 27: 10:30-12:00 A.M.	TUESDAY, Nov. 28: 8:30-10:00 A.M.
<p><b>1. Combined Radiotherapy-Chemotherapy Symposium in the Treatment of Cancer</b>            Justin J. Stein, M.D.            Moderator            Oscar Creech, Jr., M.D.            Leon O. Jacobson, M.D.            Gilbert H. Fletcher, M.D.            James J. Nickson, M.D.</p> <p><b>4:30-5:30 P.M.</b></p> <p><b>2. Introduction to Cineradiography</b>            H. M. Stauffer, M.D.            Moderator            M. S. Potaid, M.D.            E. W. Webster, Ph.D.</p> <p><b>7:30-9:30 P.M.</b></p> <p><b>3. Film Interpretation Session</b>            Ted F. Leigh, M.D.            Moderator            Lois C. Collins, M.D.            John W. Hope, M.D.            Robert E. Wise, M.D.            William T. Meszaros, M.D.</p>	<p><b>4. The Small Intestine (Cont. Tuesday)</b>            Richard H. Marshak, M.D.</p> <p><b>5. Radiology of the Larynx and Pharynx (Cont. Tuesday)</b>            Arnold L. Bachman, M.D.</p> <p><b>6. Metabolic and Endocrine Diseases Involving the Skeletal System (Cont. Tuesday)</b>            Howard L. Steinbach, M.D.</p> <p><b>7. Radiology of Congenital Heart Disease (Cont. Tuesday)</b>            John A. Campbell, M.D.            Eugene C. Klatte, M.D.</p> <p><b>8. Aorto-arteriography in the Management of Atherosclerosis of the Aorta, Iliac and Femoropopliteal Arteries</b>            Stanley M. Rogoff, M.D.            James A. DeWeese, M.D.</p> <p><b>9. Treatment of Cancer of the Larynx</b>            Juan A. del Regato, M.D.</p> <p><b>10. Treatment Planning: Conventional Energy-X-Rays</b>            A. Raventos, M.D.            J. Hale, Ph.D.</p> <p><b>11. Therapeutic Applications of Radioactive Isotopes</b>            E. R. King, M.D.</p> <p><b>12. History and Development of Radium Applicators and Systems of Dosimetry</b>            E. F. Focht, B.A.</p> <p><b>13. Radiobiology for Radiologists</b>            E. L. Saenger, M.D.</p> <p><b>14. Fluoroscopy: Physics, Electronics, and Physiology (Cont. Monday)</b>            E. W. Webster, Ph.D.</p> <p><b>15. Ionization Dosimetry</b>            R. Loevinger, Ph.D.</p>	<p><b>16. Colon: Symposium Reviewing General Disease Entities</b>            George A. Miller, M.D.            W. George Belanger, M.D.            John W. Clark, M.D.</p> <p><b>17. Renal Angiography</b>            Olle Olsson, M.D.</p> <p><b>18. Plain Film Examination of the Skull</b>            Paul F. J. New, M.D.</p> <p><b>19. Early Radiologic Recognition of Pancreatic Carcinoma</b>            Julian O. Salik, M.D.</p> <p><b>20. Management of Carcinoma of the Cervix</b>            Orless Wildermuth, M.D.</p> <p><b>21. Radiation Chemotherapy: Cancer Studies with Interior Controls</b>            Milton Friedman, M.D.</p> <p><b>22. Breast Roentgenography</b>            J. Gershon-Cohen, M.D.            S. M. Berger, M.D.</p> <p><b>23. Simultaneous Biliradiography: Technic and Interpretation</b>            Oscar M. Weaver, Jr., M.D.</p> <p><b>24. Fluoroscopy: Physics, Electronics, and Physiology (Cont. from Monday)</b>            E. W. Webster, Ph.D.</p> <p><b>25. The Radiologist and the Law</b>            Vincent P. Collins, M.D.</p> <p><b>26. Architectural Planning of a Department of Radiology</b>            G. W. Callendine, Ph.D.</p>	<p><b>27. Radiology of Congenital Heart Disease (Cont. from Monday)</b>            John A. Campbell, M.D.            Eugene C. Klatte, M.D.</p> <p><b>28. Treatment Planning with High Energy Radiation (particularly Telecobalt)</b>            L. A. DuSault, A. B.            E. J. Bloor, M.D.</p> <p><b>29. Diagnostic Applications of Radioactive Isotopes (Cont. Wednesday)</b>            J. P. Storaasli, M.D., J. H. Christie, M.D., J. S. Krohmer, M.A.</p> <p><b>30. Teleortogendiagnosis</b>            Albert Iutras, M.D.            Guy Duckett, M.D.</p> <p><b>31. Neuroradiology (Cont. Wednesday)</b>            Alfred L. Schmitz, M.D.</p> <p><b>32. Interstitial Radium Therapy (Cont. Wednesday)</b>            John Boland, M.D.            Sergei Fettelberg, M.D., Ph.D.</p> <p><b>33. Advanced Carcinoma of the Breast</b>            Orless Wildermuth, M.D.</p> <p><b>34. Small Intestine (Cont. from Monday)</b>            Richard H. Marshak, M.D.</p> <p><b>35. Larynx and Pharynx (Cont. from Monday)</b>            Arnold L. Bachman, M.D.</p> <p><b>36. Metabolic and Endocrine Diseases Involving the Skeletal System (Cont. from Monday)</b>            Howard L. Steinbach, M.D.</p> <p><b>37. Basic Radiation Dosimetry</b>            H. O. Wyckoff, Ph.D.</p> <p><b>38. Federal, State, and Local Regulations on the Use of Radiation</b>            C. B. Braestrup, B.S.</p>

WEDNESDAY, Nov. 29: 8:30-10:00 A.M.	THURSDAY, Nov. 30: 8:30-10:00 A.M.	FRIDAY, Dec. 1: 8:30-10:00 A.M.
39. Bronchography William Mohr, M.D.	51. Special Problems in Bronchography Björn Nordenström, M.D.	63. Respiratory Distress in the Newborn Victor G. Mikity, M.D.
40. The Upper Gastrointestinal Tract (Cont. Thursday) Wendell P. Stampfli, M.D.	52. Epidemiological Statistics H. Auerbach, Ph.D.	64. Pulmonary Manifestations of the Collagen Diseases William R. Eyster, M.D. Joseph C. Sieracki, M.D.
41. Neuroradiology (Cont. from Tuesday) Alfred L. Schmitz, M.D.	53. Roentgen Manifestations of Some Diseases of Bones and Joints (Cont. from Wednesday) Harold G. Jacobson, M.D.	65. Cerebral Angiography (Cont. from Thursday) J. E. Whiteleather, M.D.
42. Interstitial Radium Therapy (Cont. from Tuesday) John Bolland, M.D. Sergei Feitelberg, M.D., Ph.D.	54. Myelography: Technic and Interpretation (Cont. from Wednesday) Sidney P. Traub, M.D.	66. Angiocardiographic Findings in Congenital Heart Disease William T. Meszaros, M.D.
43. Roentgen Manifestations of Some Diseases of Bones and Joints (Cont. Thursday) Harold G. Jacobson, M.D.	55. Cerebral Angiography (Cont. Friday) J. E. Whiteleather, M.D.	67. Diagnosis and Prognosis of Bone Tumors Gwilym S. Lodwick, M.D.
44. Myelography: Technic and Interpretation (Cont. Thursday) Sidney P. Traub, M.D.	56. Examination of the Gastrointestinal Tract in Infants and Children Lawrence A. Davis, M.D.	68. Practical Techniques in Pediatric Radiology Lawrence A. Davis, M.D.
45. Total-Body Irradiation E. R. King, M.D. E. W. Webster, Ph.D. M. L. Jacobs, M.D. F. V. Comas, M.D. V. P. Collins, M.D.	57. Radiation Therapy of Lung Cancer Eugene Bronstein, M.D. Edward Holodny, B.S.	69. The Clinical Evaluation of the Effectiveness of Radiation Therapy in the Management of Carcinoma of the Cervix and Corpus Uteri with the Expanding Type of Radium Applicator E. C. Ernst, M.D.
46. Radiotherapeutic Practices (with Special Reference to the Head and Neck) Isadore Lampe, M.D.	58. The Practice of Radiology Earl E. Barth, M.D. William E. Stronach, LL.B.	70. The Quiz Show Jerome F. Wiot, M.D. Benjamin Felson, M.D.
47. Applications of Computers in Radiology W. Siler, M.S.	59. Cancer Quackery: The Problem and the Cure Sol R. Baker, M.D.	71. Cancer Chemotherapy in Radiological Practice Bernard Roswit, M.D. Julius Wolf, M.D. Lloyd S. Rogers, M.D.
48. Mammalian Radiobiology E. F. Riley, Ph.D.	60. The Upper Gastrointestinal Tract (Cont. from Wednesday) Wendell P. Stampfli, M.D.	72. Bone-Marrow Transplantation in Radiation Protection V. P. Bond, M.D.
49. Diagnostic Applications of Radioactive Isotopes (Cont. from Tuesday) J. P. Storaasli, M.D. J. H. Christie, M.D. J. S. Krohmer, M.A.	61. Dosimetry in the Therapeutic Uses of Radioisotopes W. K. Sinclair, Ph.D.	73. Radioactive Isotope Counting Statistics S. Feitelberg, M.D., Ph.D.
50. Radiation Chemical Dosimetry N. F. Barr, Ph.D.	62. Problems in the Use of the Condenser r-Meters G. D. Adams, Ph.D.	74. Instrumentation for Clinical Radiological Physics C. S. Simons, Ph.D.

enhancement, storage, and stereoscopy. Consideration will be given to the possibilities of dose reduction.

(This course continued Monday, Course No. 24)

**Course No. 15: Monday, 8:30-10:00 A.M.**

**Ionization Dosimetry**

R. LOEVINGER, Ph.D., Palo Alto, Calif.

The basis of ionization dosimetry is the Bragg-Gray equation, which has been reformulated in recent years by various workers, notably Laurence, Burch, Spencer, and Attix. These modern formulations call for a knowledge of the nature of the primary beam, the details of the cavity walls and the gas, and the true cavity ionization corrected for recombination loss and spurious ionization. In addition, they call for theoretical information on the spectrum of secondary electrons, the average energy per ion pair, and the relative stopping power, for which reliable numerical values are now available. It is not always necessary, however, to know all of these quantities with precision. Depending on whether the purpose at hand is the study of cavity theory, or absolute dosimetry, or relative dosimetry, the experimental procedures can be so arranged that results are insensitive to the values of some of these parameters. Absolute ionization dosimetry can be performed to an accuracy of about 3 per cent, relative dosimetry to an accuracy of about 1 per cent.

**Course No. 16: Monday, 10:30-12:00 A.M.**

**Colon: Symposium Reviewing General Disease Entities**

GEORGE A. MILLER, M.D., Moderator, Urbana, Ill.  
W. GEORGE BELANGER, M.D., Detroit, Mich.  
JOHN W. CLARK, M.D., Chicago, Ill.

A general review of diseases and abnormalities of the colon will be presented based on proved cases, with primary emphasis on inflammatory lesions, carcinomas, rotational abnormalities, and volvulus.

**Course No. 17: Monday, 10:30-12:00 A.M.**

**Renal Angiography**

OLLE OLSSON, M.D., Sweden

The different aspects of the technic of renal angiography will be discussed, especially selective versus aortic approach. The risks incurred in the two types of examinations will be mentioned.

Normal anatomy of the renal arteries will be outlined, indications for renal angiography discussed, and the results illustrated by renal angiograms of different diseases.

**Course No. 18: Monday, 10:30-12:00 A.M.**

**Plain Film Examination of the Skull**

PAUL F. J. NEW, M.D., Boston, Mass.

A wide range of congenital and acquired diseases will be discussed, with particular emphasis upon

early detection of disease. The value and limitations of plain film examination of the skull in the diagnosis of intracranial disease will be stressed. Slides of illustrative cases will be used throughout. Contrast studies will be demonstrated only to the extent that these provide information concerning the lesions responsible for the changes on plain films.

**Course No. 19: Monday, 10:30-12:00 A.M.**

**Early Radiologic Recognition of Pancreatic Carcinoma**

JULIAN O. SALIK, M.D., Baltimore, Md.

The clinical diagnosis of malignant tumors of the pancreato-ampullary area is sometimes difficult, as the manifestations of this disease are so protean. Growth of these tumors is usually rapid, and treatment in late stages is unsatisfactory. With recent advances in operative technics, an early diagnosis followed by immediate surgery might prove to be life-saving.

The radiologic picture produced by larger lesions of the pancreas has been adequately described, but the subtle changes on the mesial border of the duodenum are often overlooked. Pathological changes in this area are manifested by disordered motor function; the folds appear normal in one segment and display an alteration in width, height, and direction in another segment. This thesis, that early, even unsuspected, changes of the pancreas can be detected will be developed, and a number of representative cases shown. In addition to slides, cineradiographic studies of pancreatic carcinomas will be presented, and their usefulness as compared to conventional examinations evaluated. Also, the differential diagnosis of various benign and malignant conditions encountered in the pancreato-ampullary area will be discussed and illustrated by representative cases.

**Course No. 20: Monday, 10:30-12:00 A.M.**

**Management of Carcinoma of the Cervix**

ORLISS WILDERMUTH, M.D., Seattle, Wash.

A step-by-step presentation in the diagnosis and treatment of the various stages of carcinoma of the cervix will be undertaken. The advantages and rationale of a specific method will be developed and, as time permits, comparison with other technics will be drawn. An attempt will be made to evaluate the complications of irradiation and their management, and to point out the areas in which the general radiologist should be expected to take responsibility in the management of this crucial disease.

**Course No. 21: Monday, 10:30-12:00 A.M.**

**Radiation Chemotherapy: Cancer Studies with Interior Controls**

MILTON FRIEDMAN, M.D., New York, N. Y.

This presentation is based on more than a hundred cases treated with radiation combined with chemo-



therapy under an experimental control plan. Several preliminary observations concerning the indication for certain drugs and for combined therapy will be given. Cancers of the mouth, pharynx, lung, gastrointestinal tract, bone, and Wilms' tumors were included in the study. Serial biopsies were frequently done. Methotrexate and 5-fluorouracil were the chemotherapeutic agents most often employed.

In some cases, a single tumor in which the lethal tumor dose is known was treated with a sublethal tumor dose and chemotherapy was utilized in addition. The same plan was utilized on some radio-lucent bone tumors. In some instances, different node groups in the same patient were used for control and for the combined therapy. Suggestions for the practical clinical employment of radiation combined with chemotherapy will be offered.

#### Course No. 22: Monday, 10:30-12:00 A.M.

##### Breast Roentgenography

I. GERSHON-COHEN, M.D., D.Sc. (Med), Philadelphia, Penna.

S. M. BERGER, M.D., Philadelphia, Penna.

This topic will be divided into six categories. (1) Historical; (2) Technic; (3) The Normal Breast; (4) The Dysplasias; (5) Neoplasia; and (6) The Role of the Roentgenologist and Surgeon in the Prevention of Delays in Diagnostic Resection.

The difficulties and limitation of roentgenographic diagnosis in certain forms of cancer, especially those associated with adenosis and mastopathy, will be reviewed. The value of an x-ray survey method for detection of early cancer will be discussed.

#### Course No. 23: Monday, 10:30-12:00 A.M.

##### Simultaneous Biligraphy: Technic and Interpretation

OSCAR M. WEAVER, JR., M.D., Welch, W. Va.

Analogous to intravenous urography, simultaneous biligraphy is a specific procedure designed to evaluate the status of bile flow throughout the intact extrahepatic biliary tract. Functional information concerning gallbladder and sphincter of Oddi responses to ingested fat, intravenous cholecystokinins, parasympathomimetics, and methantheline derivatives is obtained, in addition to pathomorphological information involving component structures, singly or in combination. The procedure defines the limitations of oral cholecystography. A working classification of disorders based upon characteristics of abnormal bile flow will be distributed.

#### Course No. 24: Monday, 10:30-12:00 A.M.

##### Fluoroscopy: Physics, Electronics, and Physiology

E. W. WEBSTER, Ph.D., Boston, Mass.

(Continued from Monday, Course No. 14)

#### Course No. 25: Monday, 10:30-12:00 A.M.

##### The Radiologist and the Law

VINCENT P. COLLINS, M.D., Houston, Texas

There is an understandable reluctance on the part of all physicians to participate in court proceedings dealing with malpractice, negligence, or personal injury suits either as expert witnesses or as defendants. In this area of high interest to the radiologist very little effort has been expended by way of thoughtful preparation to avoid participation and to minimize hazards. The areas in which the radiologist should be informed are legal bibliography, the status of the expert witness, tort liability in medical practice, and legislative action. This course will offer a summary of pertinent information while exploring the depth and direction of interest that may exist for continued instruction in this field.

#### Course No. 26: Monday, 10:30-12:00 A.M.

##### Architectural Planning of a Department of Radiology

G. W. CALLENDINE, Ph.D., Columbus, Ohio

Some radiology departments are planned; others just grow. Many architects consider the radiology department the most complex department in the hospital to design successfully. The reasons for this will be considered. The roles of the various persons responsible for the planning of a department and their interrelations will be discussed. Type of planning will be related to patients, to method of practice, to consulting medical staff, and to employees. Specific problems in design will be studied. These will include traffic flow (patient, personnel, films, and records), processing, placement of equipment, shielding requirements, and others. Differences in approach necessitated by new and remodeling planning will be discussed, as will some of the aspects of office vs. hospital practice. Specific departments will be analyzed to demonstrate strengths and weaknesses of planning. Sufficient time will be allotted to permit discussion of problems from the floor.

#### Course No. 27: Tuesday, 8:30-10:00 A.M.

##### Radiology of Congenital Heart Disease

JOHN A. CAMPBELL, M.D., Indianapolis, Ind.

EUGENE C. KLATTE, M.D., Indianapolis, Ind.

(Continued from Monday, Course No. 7)

#### Course No. 28: Tuesday, 8:30-10:00 A.M.

##### Treatment Planning with High Energy Radiation (Particularly Telecobalt)

LUCILLE A. Du SAULT, A.B., Detroit, Mich.

ROBERT J. BLOOR, M.D., Detroit, Mich.

Dosage calculation for stationary and rotational technics will be explained, including special problems



such as oblique fields, compensating filters, and changes in treatment distance. Ways of altering dose distribution will be described for both technics. Clinical factors governing the type of treatment plan will be discussed in reference to the choice of specific field arrangements.

**Course No. 29: Tuesday, 8:30-10:00 A.M.**

**Diagnostic Applications of Radioactive Isotopes**

J. P. STORAASLI, M.D., Cleveland, Ohio  
J. H. CHRISTIE, M.D., Cleveland, Ohio  
J. S. KROHMER, M.A., Dallas, Texas

The most common diagnostic uses of radioactive isotopes will be discussed. Physical requirements, as well as the physiopathological criteria for the various clinical applications, will be included. Isotopes to be covered are  $I^{131}$  (iodide, serum albumin, rose bengal)  $Cr^{51}$ ,  $P^{32}$ ,  $Au^{198}$ , and  $Co^{60}$ . The diagnostic applications to be discussed are:

1. Thyroid function studies including uptakes, clearance rates, PBI's, and TSH tests
2.  $P^{32}$  in the diagnosis of intraocular tumors
3. Metabolic studies including pancreatic insufficiency studies and assay of "intrinsic factor"
4. The use of  $Fe^{59}$  and  $Cr^{51}$  in hematologic disorders
5. Body scanning, including thyroid, liver, and blood pools

(This course continued Wednesday, Course No. 49)

**Course No. 30: Tuesday, 8:30-10:00 A.M.**

**Teleroentgendiagnosis**

ALBERT JUTRAS, M.D., Montreal, Quebec, Canada  
GUY DUCKETT, M.D., Montreal, Quebec, Canada

A method for radiological examinations performed from an adjacent room by means of television, motion pictures, and a switchboard will be described. Practicability, diagnostic value, and economical aspects of remote control, TV-fluoroscopy, procedures of picture recording, tele-transmission, etc., will be discussed.

**Course No. 31: Tuesday, 8:30-10:00 A.M.**

**Neuroradiology**

ALFRED L. SCHMITZ, M.D., Los Angeles, Calif.

Bone changes in meningiomas, acoustic-nerve tumors, and sellar tumors will be discussed. The technic and the normal roentgen anatomy in fractional encephalography will be illustrated. Normal encephalograms will be compared with those showing changes in the ventricular system and cisterns secondary to tumor pathology. Cerebral arteriograms will be presented to augment the encephalographic studies.

(This course continued Wednesday, Course No. 41)

**Course No. 32: Tuesday, 8:30-10:00 A.M.**

**Interstitial Radium Therapy**

JOHN BOLAND, M.D., New York, N. Y.  
SERGEI FEITELBERG, M.D., Ph.D., New York, N.Y.

This course is related to Course No. 12.

1. Indications for interstitial therapy at various sites of the body
2. Implant planning
3. Radium stock
4. Radium substitutes
5. Surgical technic
6. Reconstruction of implant; dose and time calculation
7. Nursing care, management of acute and chronic reaction
8. End-results in relation to volume dose and time
9. Optimum dose at various sites

(This course continued Wednesday, Course No. 42)

**Course No. 33: Tuesday 8:30-10:00 A.M.**

**Advanced Carcinoma of the Breast**

ORLISS WILDERMUTH, M.D., Seattle, Wash.

Radiation therapy is widely accepted for the relief of pain in carcinoma of the breast with metastasis to bone. Because of this, the radiation therapist is frequently met with the problem of terminal care in advanced mammary carcinoma. This course is designed to provide a perspective on which to build the total care and form of an organized retreat in an advanced disease. The major forms of useful procedures will be presented.

**Course No. 34: Tuesday, 8:30-10:00 A.M.**

**The Small Intestine**

RICHARD H. MARSHAK, M.D., New York, N. Y.

(Continued from Monday, Course No. 4)

**Course No. 35: Tuesday, 8:30-10:00 A.M.**

**Radiology of the Larynx and Pharynx**

ARNOLD L. BACHMAN, M.D., New York, N. Y.

(Continued from Monday, Course No. 5)

**Course No. 36: Tuesday, 8:30-10:00 A.M.**

**Metabolic and Endocrine Diseases Involving the Skeletal System**

HOWARD L. STEINBACH, M.D., San Francisco, Calif.

(Continued from Monday, Course No. 6)

**Course No. 37: Tuesday, 8:30-10:00 A.M.**

**Basic Radiation Dosimetry**

H. O. WYCKOFF, Ph.D., Silver Spring, Md.

The text for this course is the 1959 *Recommendations of the International Commission on Radiological*

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THE RADIOLOGICAL SOCIETY  
OF NORTH AMERICA

*November 26 through December 1*

THE PALMER HOUSE  
CHICAGO, ILLINOIS

SEE INSTRUCTIONS ON REVERSE SIDE

(Detach here)

## FILL OUT THE FOLLOWING

(You must identify yourself at the Registration Desk)

(Print or type).....

Last Name

First Name or Initials

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## CHECK THE FOLLOWING

Member R.S.N.A. ☐

Guest ☐

Resident or Fellow in Radiology at present ☐

Where.....

Medical Student\* ☐

Where.....

Reserve Officer on Active Duty at present ☐

Trainee in Physics ☐

\* You must present a letter of identification from the Dean of your Medical School.

Fill out, also, the enrollment diagram on the reverse side of this page.

## INSTRUCTIONS FOR ENROLLMENT

Read the accompanying description of the courses and plan of presentation. Register early; the number admitted to each course will be limited by the seating capacity of the room. Reservations will be made in the order of the receipt of request. Admission to the Refresher Courses will be by badge and tickets except for Courses Nos. 1, 2, and 3, for which only a badge will be required. No tickets will be issued for these sessions.

Courses are limited to the medical profession, including graduate students and residents in radiology; radiation physicists, radiobiologists, chemists, and others closely allied with the science of radiology; and medical students certified by the deans of their respective colleges.

Residents, interns, and *medical students* may be limited to courses being presented in the Grand Ball Room, Red Lacquer Room, and State Room.

All tickets will be held for you at the R.S.N.A. Registration Desk in the Palmer House.

The registration fee, where applicable, will cover the cost of the Refresher Courses. Members, guest speakers, guest instructors, scientific exhibitors, residents or fellows in radiology, medical students, members of the Armed Forces, and trainees in physics do not pay a registration fee. Non-members not in these groups will pay, *at the time of registration*, a fee of \$25.00, which will include the Refresher Courses.

*If you cannot attend the course reserved for you, kindly notify the Refresher Course Chairman. The seating capacity is very limited in some of the courses and your notice will allow another to attend.*

### PLEASE INDICATE YOUR FIRST, SECOND, AND THIRD CHOICES

Tickets Will Be Picked Up at Time of Registration

	First Choice		Second Choice		Third Choice	
	Course No.	Instructor	Course No.	Instructor	Course No.	Instructor
Monday, Nov. 27 8:30 A.M.						
Monday, Nov. 27 10:30 A.M.						
Tuesday, Nov. 28						
Wednesday, Nov. 29						
Thursday, Nov. 30						
Friday, Dec. 1						

Mail this order sheet to John D. Reeves, M.D., Chairman, Refresher Course Committee

Prior to Nov. 18, University of Florida Hospital, Gainesville, Florida

After Nov. 18, c/o Radiological Society of North America, The Palmer House, Chicago, Illinois

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*Units and Measurements (NBS Handbook 78).* The difference between the exposure dose in roentgens, the absorbed dose in rads, and the RBE dose in rems will be pointed out. Data on energy dependence and rate dependence of r-meters will be presented, and suggestions will be made on methods for checking the reproducibility of such instruments. Direct measurement of the absorbed dose by calorimetric means will be discussed, but the principal method considered will be the computation of absorbed dose from ionization measurements.

**Course No. 38: Tuesday, 8:30-10:00 A.M.**

**Federal, State, and Local Regulations on the Use of Radiation**

C. B. BRAESTRUP, P.E., New York, N. Y.

Various national and international groups are concerned with the preparation of radiation standards. However, most state and local radiation protection regulations for medical applications are based on the recommendations of the National Committee for Radiation Protection as published in various NBS handbooks, of which *H-73* on gamma sources and *H-76* on x-rays are of particular interest to radiologists. Pertinent changes in the new handbooks will be discussed in detail.

Special consideration will be given to the design of radiation shielding to meet present standards. With the reduction of the MPD for noncontrolled areas by a factor of 30, greater attention should be given to all the factors affecting the shielding requirements. This is necessary in order to ensure ample protection at minimum cost. In the case of teletherapy and high-energy installations the weight of the shielding may be a determining factor.

**Course No. 39: Wednesday, 8:30-10:00 A.M.**

**Bronchography**

WILLIAM MOLNAR, M.D., Columbus, Ohio

Aerosol topical anesthesia for bronchography, utilizing positive pressure breathing apparatus, has many advantages in comparison with hand-controlled spraying of an analgesic agent. With this new approach bronchography becomes a less tiresome procedure, more readily acceptable to the patient. Detailed discussion of a simple bronchographic technic will be presented, followed by demonstration of the normal anatomy and variations of the bronchial tree. Bronchographic findings in pulmonary emphysema, chronic bronchitis, bronchiectasis, and carcinoma of the lung will be discussed. The altered bronchopulmonary dynamics in these conditions will be shown on a movie made by a 9-inch image amplifier. There will be special emphasis on differential diagnosis between benign and malignant endobronchial lesions. The clinical material presented in this course has been selected from more than 3,000 bronchographic examinations.

**Course No. 40: Wednesday, 8:30-10:00 A.M.**

**The Upper Gastrointestinal Tract**

WENDELL P. STAMPFLI, M.D., Denver, Colo.

The technic of the upper gastrointestinal tract examination will be reviewed, with special emphasis on the method of mucosal exploration. Lesions that involve the esophagus, and particularly those that affect its motility and the integrity of its opening and closing mechanism, will be discussed. An attempt will be made to describe the roentgenologic dissimilarities that exist in benign and malignant disease of the stomach and, finally, the subject of postbulbar ulcer will be presented in detail. These ulcers constitute an important clinical entity with interesting radiographic features. One feature, the "pseudo-mass" deformity, will be stressed because it sometimes leads to a diagnosis of neoplasm.

(This course continued Thursday, Course No. 60)

**Course No. 41: Wednesday, 8:30-10:00 A.M.**

**Neuroradiology**

ALFRED L. SCHMITZ, M.D., Los Angeles, Calif.

(Continued from Tuesday, Course No. 31)

**Course No. 42: Wednesday, 8:30-10:00 A.M.**

**Interstitial Radium Therapy**

JOHN BOLAND, M.D., New York, N. Y.  
SERGEI FEITELBERG, Ph.D., M.D., New York, N. Y.

(Continued from Tuesday, Course No. 32)

**Course No. 43: Wednesday, 8:30-10:00 A.M.**

**Roentgen Manifestations of Some Diseases of Bones and Joints**

HAROLD G. JACOBSON, M.D., New York, N. Y.

*The Arthritides and Allied Disorders:* Tuberculosis, rheumatoid arthritis and spondylitis, psoriatic arthritis, suppurative arthritis, osteoarthritis, spondylosis deformans, "swayback" syndrome, gout, neuropathic joints, sarcoid, pigmented villonodular synovitis, synovial osteochondromatosis and synovoma.

*Miscellaneous Skeletal Abnormalities:* Paget's disease, fibrous dysplasia, leontiasis ossium, caisson workers' aseptic necrosis, Gaucher's disease, skeletal findings in various blood dyscrasias (agranulocytosis, myeloid metaplasia, leukemia, etc.), the important so-called aseptic necroses in childhood (Köhler's, Kienböck's, Freiberg's, osteochondritis dissecans, osteochondrosis of the spine, Legg-Perthes, etc.), idiopathic coxa vara of childhood, slipping of the femoral capital epiphysis, the reticuloses (eosinophilic granuloma, Hand-Christian-Schüller disease, Letterer-Siwe disease), hyperparathyroidism.

A concise description of the pathologic changes in each of these entities will be presented, and the relationship of the pathologic findings to the roentgen manifestations will be discussed. The concept of

explaining the roentgen findings in terms of the pathologic changes will receive special emphasis.

(This course continued Thursday, Course No. 53)

#### Course No. 44: Wednesday, 8:30-10:00 A.M.

##### Myelography: Technic and Interpretation

SIDNEY P. TRAUB, M.D., Saskatoon, Sask., Canada

This course is designed to cover the practical aspects of myelography of importance to the roentgenologist. The following outline will be observed:

##### Part I

1. Brief historical review
2. Indications for myelography; contraindications
3. Pertinent anatomy and anatomic variations of subarachnoid space
4. Basic principles in myelographic technic
5. Complications of myelography and their significance
6. Intervertebral disk protrusions:
  - a. Value of chest and spine roentgenograms
  - b. Cervical disk protrusions
  - c. Thoracic disk protrusions
  - d. Lumbar disk protrusions
7. The postoperative myelogram
8. Limitations of diskography; gas myelography; water-soluble myelography

##### Part II

1. Congenital lesions:
  - a. Diastematomyelia
  - b. Lumbar, sacral, and intrathoracic meningoceles
  - c. Perineurial and extradural cysts
2. Vascular malformations
3. Traumatic lesions
4. Inflammatory lesions
5. Intraspinal tumors: Extradural, intradural (extramedullary), and intramedullary tumors will be discussed under:
  - a. Classification and incidence
  - b. Plain film changes
  - c. Myelography appearance
6. Summary and general discussion including:
  - a. Common errors in myelographic interpretation
  - b. Value and limitations of the myelographic examination in patients with intraspinal disease

(This course continued Thursday, Course No. 54)

#### Course No. 45: Wednesday, 8:30-10:00 A.M.

##### Total-Body Irradiation

E. R. KING, M.D., Richmond, Va.  
 E. W. WEBSTER, Ph.D., Boston, Mass.  
 M. L. JACOBS, M.D., Duarte, Calif.  
 F. V. COMAS, M.D., Oak Ridge, Tenn.  
 V. P. COLLINS, M.D., Houston, Texas

The use of total-body irradiation in clinical radiology has attracted renewed interest in recent

years. This is primarily due to its reapplication in the treatment of far advanced, widespread cancer, as well as its use as a method of eliminating the immune response mechanism in preparation of a patient for organ transplantation.

Within the past several months, rooms designed for total-body irradiation therapy have been completed at Oak Ridge, Tenn., and at the City of Hope Medical Center. Several other institutions, with equipment already available, are also evaluating this treatment method.

This course will present material on physical design of total-body irradiation units, as well as technics and early clinical results from several centers now utilizing this form of radiation therapy.

#### Course No. 46: Wednesday, 8:30-10:00 A.M.

##### Radiotherapeutic Practices

(With Special Reference to the Head and Neck)

ISADORE LAMPE, M.D., Ann Arbor, Mich.

Principles and methods employed at the University of Michigan to insure proper beam direction and reproducibility of treatment set-ups will be discussed. Pre-treatment localization technics will be demonstrated as applied in practice, chiefly to head and neck lesions. In addition a peroral irradiation technic for carcinoma of the oral part of the tongue will be presented. Some short-term and some long-term results will be reported.

#### Course No. 47: Wednesday, 8:30-10:00 A.M.

##### Applications of Computers in Radiology

W. SILER, M.S., New York, N. Y.

Basic principles of digital computers will be reviewed, including capabilities and limitations, instructions, memory, input-output devices, and programming systems. Applications to the field of Radiology will include treatment planning, implant dosimetry, calculation of isodose curves, spectral analysis, handling and search of medical records, and the like.

There will be a brief discussion of applications of computers to such fields as metabolic analysis, differential diagnosis, analysis of the EEG and EKG, and on-line monitoring of operating room procedures.

#### Course No. 48: Wednesday, 8:30-10:00 A.M.

##### Mammalian Radiobiology

E. R. RILEY, Ph.D., Iowa City, Iowa

Some present-day concepts of radiobiology will be discussed. Illustrative examples will be selected from reports of laboratory experiments, especially

those in which laboratory mammals were utilized. The following general topics will be considered.

1. The very early physical and chemical events which occur in biological material upon exposure to ionizing radiation. The concept of a sensitive volume and one-hit or multi-hit survival curves will be discussed.

2. The early cytological effects (effects observed during the first seven days post-irradiation). Discussion will include alterations of the mitotic cycle, chromosome abnormalities, and some accounts of cytoplasmic alterations.

3. Acute effects (during first thirty days) observed in mammals. Variations in sensitivity of tissues, latent periods, and the syndrome concept will be discussed. Factors which modify the responses to radiation (including the effect of  $O_2$ ) will also be considered.

4. Some discussion of late effects observed among survivors of sublethal doses will be included.

#### Course No. 49: Wednesday, 8:30-10:00 A.M.

##### Diagnostic Applications of Radioactive Isotopes

J. P. STORAASLI, M. D., Cleveland, Ohio  
J. H. CHRISTIE, M.D., Cleveland, Ohio  
J. S. KROHMER, M.A., Dallas, Texas

(Continued from Tuesday, Course No. 29)

#### Course No. 50: Wednesday, 8:30-10:00 A.M.

##### Radiation Chemical Dosimetry

N. F. BARR, Ph.D., New York, N. Y.

The theory of radiation chemical dosimetry will be discussed with special reference to clinical and radiobiological applications. Chemical dosimetry will be contrasted with ionization methods and the advantages and limitations stressed with the aid of numerous examples of the use of chemical dosimetry. Early developments in chemical dosimetry will be briefly reviewed and G will be compared with W.

Basic principles of the radiation chemistry of aqueous solutions will be reviewed and their bearing on chemical dosimetry stressed. The behavior of chemical dosimeters in general will be discussed in light of these principles, using the Fricke ferrous sulfate dosimeter as a particular example. Determination of the G value and matching of mean atomic number will be stressed.

The application of the foregoing principles to the development of more sensitive chemical systems will be discussed and several examples of more sensitive systems presented.

Finally, particular examples of the use of chemical dosimeters in a variety of clinical situations such as implant dosimetry, whole body and gonadal dose determinations, RBE studies, depth-dose determinations, isotope dosimetry, and dosimetry of mixed radiation fields will be discussed.

#### Course No. 51: Thursday, 8:30-10:00 A.M.

##### Special Problems in Bronchography

BJÖRN NORDENSTRÖM, M.D., Stockholm, Sweden

A special technic developed at Thoraxkliniken, Karolinska Sjukhuset, called aspiration bronchography, will be demonstrated in a movie. In con- cedure will be discussed in relation to other methods of bronchography. The experience of the technic is based on a large series of bronchographies performed during the last ten years, and some of the diagnostic possibilities connected with this technic will also be demonstrated.

#### Course No. 52: Thursday, 8:30-10:00 A.M.

##### Epidemiological Statistics

H. AUERBACH, Ph.D., Argonne, Ill.

The lecture will cover a general consideration of some fundamental aspects of epidemiological statistics and a more detailed examination of a specific problem application currently of interest to radiologists. The topics dealt with under general considerations will include: the role of the observer (experimenter) and his effect on the study; some considerations in experimental design; defining the population and the sample; bias, randomness, and variation in experiments; statistical analysis and significance testing; interpretation of results. The specific application to be discussed will be the results of studies on the relationship of prenatal irradiation and incidence of leukemia. The apparently conflicting results of several workers in this field will be reviewed and reconciliation attempted.

#### Course No. 53: Thursday, 8:30-10:00 A.M.

##### Roentgen Manifestations of Some Diseases of Bones and Joints

HAROLD G. JACOBSON, M.D., New York, N. Y.

(Continued from Wednesday, Course No. 43)

#### Course No. 54: Thursday, 8:30-10:00 A.M.

##### Myelography: Technic and Interpretation

SIDNEY P. TRAUB, M.D., Saskatoon, Sask., Canada

(Continued from Wednesday, Course No. 44)

#### Course No. 55: Thursday, 8:30-10:00 A.M.

##### Cerebral Angiography

J. E. WHITELEATHER, M.D., Memphis, Tenn.

This course will be divided into two sessions. As it is impossible to cover the entire field, very little time will be spent on anatomy, clinical indications, and technic.

The first session will be concerned with the diagnosis of intracranial masses other than aneurysms,



arteriovenous anomalies, and fistulas. Emphasis will be given to correlation of pneumographic and arteriographic findings and diagnostic points of minimal lesions.

The second session will be devoted to various aspects of carotid-vertebro-basilar arteriosclerotic disease, circle of Willis anomalies, and collateral circulation experience with technics of total carotid-vertebral opacification.

(This course continued Friday, Course No. 65)

#### Course No. 56: Thursday, 8:30-10:00 A.M.

##### Examination of the Gastrointestinal Tract in Infants and Children

LAWRENCE A. DAVIS, M.D., Louisville, Ky.

Examination of the gastrointestinal tract in infants and younger children is difficult only in the technical problems involved. Actually, the range of abnormality is limited and does not compare with the pathological complexities found in the adult. This course will stress these technical problems and how they can be easily solved by the radiologist and one technician. The various congenital and acquired diseases encountered in pediatric practice will be analyzed, and the use of water-soluble opaque media will be discussed.

#### Course No. 57: Thursday, 8:30-10:00 A.M.

##### Radiation Therapy of Lung Cancer

EUGENE BRONSTEIN, M.D., New York, N. Y.  
EDWARD HOLODNY, B.S., New York, N. Y.

The role of radiotherapy in lung cancer has assumed great importance in recent years with the rapid increase in the incidence of the disease and newer technics of treatment. This course will review curative and palliative approaches to therapy, with particular attention to supervoltage. Indications and results of interstitial radiation will be considered. The use of certain chemotherapeutic agents as adjuncts to radiation therapy in lung cancer will be discussed. Treatment planning, field verification, and dosimetry will be illustrated.

#### Course No. 58: Thursday, 8:30-10:00 A.M.

##### The Practice of Radiology

EARL E. BARTH, M.D., Chicago, Ill.  
WILLIAM E. STRONACH, LL.B., Chicago, Ill.

This course is designed particularly for residents in radiology and younger radiologists. The discussion will center on: (1) radiological facts and figures, (2) ethics and economics, and (3) introduction to radiologic organization. This course grows out of a lecture series prepared for presentation to resident staffs at teaching centers and was presented, by request, in package form at the last annual meeting of the American College of Radiology.

#### Course No. 59: Thursday, 8:30-10:00 A.M.

##### Cancer Quackery: The Problem and the Cure

SOL. R. BAKER, M.D., Beverly Hills, Calif.

Unorthodox and unproved methods of cancer therapy are in extensive use today in every part of the United States. Many physicians are unaware of the magnitude of this practice, and charlatans are frequently heeded by respectable and ethical M.D.'s as well as by the gullible and desperate public.

The ultimate control is education of both the profession and the public. Radiologists, particularly the therapist, see more cancer patients than any other specialty group and probably have the best opportunity to play a significant role in the control of cancer quackery. A prerequisite is knowledge of the problem and an awareness of its existence.

This discussion will describe the most important examples of cancer quackery and attempt to formulate the position of the physicians and the courses of action that should be taken.

#### Course No. 60: Thursday, 8:30-10:00 A.M.

##### The Upper Gastrointestinal Tract

WENDELL P. STAMPFLI, M.D., Denver, Colo.

(Continued from Wednesday, Course No. 40)

#### Course No. 61: Thursday, 8:30-10:00 A.M.

##### Dosimetry in the Therapeutic Uses of Radioisotopes

W. K. SINCLAIR, Ph.D., Chicago, Ill.

The therapeutic use of radioisotopes depends on the disposition of as much radiant energy as possible at the diseased site, with the minimum dissipation of energy in healthy tissues elsewhere. Concentration of the radioactive material at the site of disease must be achieved in one of the following ways.

1. By metabolic accumulation of the isotope
2. By the physical nature of the material (colloid)
3. By deliberate localization of specific sources by intracavitary, interstitial, or superficial means

The basic principles of dosimetry for beta- and gamma-radiation will be discussed, with references to particular therapeutic procedures from each of the groups listed above.

#### Course No. 62: Thursday, 8:30-10:00 A.M.

##### Problems in the Use of the Condenser r-Meters

G. D. ADAMS, Ph.D., San Francisco, Calif.

This course is intended to bring together the experiences of many investigators regarding the characteristics of condenser r-meters and their proper usage. Because of the very large number in the field—and presumably in use—much of the actual discussion and illustration will be related to

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the Victoreen instrument. After covering the principle of operation of the instrument, including the mode of intended usage, a description of the construction of the electrometer and of the thimble portions will be given. Then will follow an extensive description of characteristics of the electrometer and of the thimble, including the several known correctable effects, as well as uncorrectable difficulties against which the only practical defense is avoidance. The special problems which are raised if the thimble is exposed in a phantom will also be considered. Some comparisons with other exposure-dose measuring systems will conclude the presentation.

#### Course No. 63: Friday, 8:30-10:00 A.M.

##### Respiratory Distress in the Newborn

VICTOR G. MIKITY, M.D., Los Angeles, Calif.

The most common causes of respiratory distress in the newborn will be reviewed. Emphasis will be placed on the differential diagnosis and on correlation with the clinical and pathological findings. The diseases will include the following:

1. Hyaline membrane disease
2. Aspiration pneumonia
3. Pneumomediastinum and pneumothorax
4. Lobar and interstitial emphysema
5. Congenital intrauterine pneumonia
6. Bacterial pneumonias
7. Congenital cystic disease of the lung
8. Idiopathic pulmonary fibrosis of the premature

#### Course No. 64: Friday, 8:30-10:00 A.M.

##### Pulmonary Manifestations of the Collagen Diseases

WILLIAM R. EYLER, M.D., Detroit, Mich.  
JOSEPH C. SIERACKI, M.D., Danville, Penna.

This course will be based on a series of patients studied radiographically and pathologically. Particular emphasis will be placed on scleroderma, but examples will be shown of all of the collagen diseases, including lupus erythematosus, periarteritis nodosa, Wegener's granulomatosis, dermatomyositis, polymyositis, rheumatoid arthritis, rheumatic fever, and thrombotic thrombocytopenic purpura. Particular emphasis will be placed on the correlation of radiographic and pathologic studies.

Some examples of other diseases producing diffuse pulmonary abnormalities will be shown for comparison. Cases of agammaglobulinemia, sarcoid, eosinophilic granuloma, and Hamman-Rich disease will be briefly illustrated from the radiologic aspect only.

#### Course No. 65: Friday, 8:30-10:00 A.M.

##### Cerebral Angiography

I. E. WHITELEATHER, M.D., Memphis, Tenn.

(Continued from Thursday, Course No. 55)

#### Course No. 66: Friday, 8:30-10:00 A.M.

##### Angiocardiographic Findings in Congenital Heart Disease

WILLIAM T. MESZAROS, M.D., Chicago, Ill.

- A. No shunt (acyanotic)
  1. Dextrocardia—complete and incomplete
  2. Idiopathic pulmonary hypertension
  3. Marfan's syndrome
  4. Coarctation of the aorta
  5. Endocardial fibroelastosis
  6. Myocarditis
  7. Bland-White-Garland syndrome
  8. Aortic stenosis
  9. Aortic regurgitation
  10. Mitral insufficiency
  11. Pulmonary valvular stenosis
  12. Pulmonary artery coarctation
- B. Left-to-right shunt
  1. Patent ductus arteriosus
  2. Atrial septal defect
  3. Ventricular septal defect
  4. Common atrioventricular canal
  5. Coronary arteriovenous fistula
  6. Aortic-pulmonary window
  7. Ruptured sinus of Valsalva
  8. Partial anomalous pulmonary venous connection
- C. Right-to-left shunt (cyanotic)
  1. Total anomalous pulmonary venous connection
  2. Valvular pulmonic stenosis with atrial communication
  3. Ebstein's anomaly
  4. Atrial septal defect with hypoplastic right ventricle
  5. Uhl's anomaly
  6. Tricuspid atresia
  7. Tricuspid stenosis with atrial communication
  8. Pentalogy
  9. Tetralogy of Fallot
  10. Truncus arteriosus
  11. Eisenmenger complex
  12. Double outlet right ventricle
  13. Taussig-Bing anomaly
  14. Complete transposition of the great vessels (corrected transposition will also be discussed here)
  15. Transposition and tricuspid atresia

#### Course No. 67: Friday, 8:30-10:00 A.M.

##### Diagnosis and Prognosis of Bone Tumors

GWILYM S. LODWICK, M.D., Columbia, Mo.

This course is concerned with an approach to the evaluation of bone tumors from two points of view: (1) How well can the histologic classifications of various primary bone tumors be identified from roentgenograms, and what are the criteria for making such distinctions? (2) To what extent may the behavior of bone tumors be predicted from roent-

genograms? (3) What are the practical applications of such predictions?

**Course No. 68: Friday, 8:30-10:00 A.M.**

**Practical Technics in Pediatric Radiology**

LAWRENCE A. DAVIS, M.D., Louisville, Ky.

The various technics successfully used in radiography and fluoroscopy in children will be demonstrated and discussed. Stress will be placed on simplicity and radiation protection. The technics used in gastrointestinal examination, excretory urography, and cardiac fluoroscopy will be detailed.

**Course No. 69: Friday, 8:30-10:00 A.M.**

**The Clinical Evaluation of the Effectiveness of Radiation Therapy in the Management of Carcinoma of the Cervix and Corpus Uteri with the Expanding Type of Radium Applicator**

E. C. ERNST, M.D., St. Louis, Mo.

The comparative radiation effectiveness of the different available therapy technics based on our clinical experiences during the past decade will be evaluated with special reference to the method of timing, intensity of the radium employed, and the distribution of the radiation sources in the pelvis.

We will then present a summation of the views, experience and information regarding clinical results of other radiotherapists and cancer clinics as expressed in their answers to a recently mailed questionnaire. This discussion will then be concluded with the presentation of clinical problem cases by those in attendance.

The advantages, disadvantages, and physical and technical considerations involved in the distribution of radium sources in the pelvis will be the subject of a Question and Answer period.

**Course No. 70: Friday, 8:30-10:00 A.M.**

**The Quiz Show**

JEROME F. WIOT, M.D., Cincinnati, Ohio  
BENJAMIN FELSON, M.D., Cincinnati, Ohio

Here's your chance to find out how much (or how little) you really know! Unusual conditions, with important teaching value, will be presented for your diagnosis. The answers will then be given, along with a pertinent discussion of the subject illustrated. No answers given out in advance! No prizes!

**Course No. 71: Friday, 8:30-10:00 A.M.**

**Cancer Chemotherapy in Radiological Practice**

BERNARD ROSWIT, M.D., Bronx, N. Y.  
JULIUS WOLF, M.D., Bronx, N. Y.  
LLOYD S. ROGERS, M.D., Syracuse, N. Y.

Cytotoxins, antimetabolites, antibiotics, radiation synergists, steroids and other agents have

recently gained great importance as adjuncts to radiation treatment. It is essential that radiologists keep abreast of these new developments to improve their management of patients with advanced disease. This course has therefore been planned by a radiologist for radiologists, to discuss available drugs, dosage, indications, clinical effectiveness, complications, and integration with the radiation treatment as well as the trend of future developments in this field.

**Course No. 72: Friday, 8:30-10:00 A.M.**

**Bone-Marrow Transplantation in Radiation Protection**

V. P. BOND, M.D., Upton, N. Y.

The background for total-body irradiation and bone-marrow transplants in the therapy of a variety of clinical conditions lies in animal radiation protection studies. These studies indicated that shielding of the spleen or injection of spleen or bone-marrow preparations affords significant protection of rodents through accelerated bone-marrow regeneration. Earlier work indicated the possibility of a humoral agent; actual cell transplantation was later demonstrated. The resultant stimulation of interest in human marrow transplants was heightened by the demonstration that mouse leukemia might be "cured" by heavy irradiation of animals followed by transplantation of normal marrow to allow survival. Later rejection of marrow homografts has occurred, probably on an antibody reaction basis, and the "secondary" or so-called "wasting disease" is seen with transplants of homologous or heterologous marrow.

Marrow transplants have now been attempted in a number of patients for leukemia, for marrow aplasia, after irradiation and kidney transplantation, and for victims of reactor accidents. These experiences will be discussed in terms of rationale, clinical indications, technics, possible preservation of marrow, evidence for successful transplant, and possible transplant rejection or other delayed effects. The doses of radiation used will be discussed in terms of the levels at which survival is possible with "supportive" measures only (antibiotics, transfusions, platelets), and the levels at which marrow transplant may be successful and may allow survival.

**Course No. 73: Friday, 8:30-10:00 A.M.**

**Radioactive Isotope Counting Statistics**

S. FEITELBERG, M.D., Ph.D., New York, N. Y.

The following topics will be presented and illustrated by numerical examples derived from experiments.

1. Randomness of nuclear decay and mathematical statistics of random events.
2. Deviation from randomness in nuclear count-

ing and its implications: application to the testing of equipment performance, numerical methods of evaluation.

3. Precision of measurements in counting: standard deviation and coefficient of variation; standard deviation for desired confidence in precision; role of sample counting rate, of background counting rate, and of their ratio.

4. Sensitivity of counting assay: limits of sensitivity and counting time; considerations for counting strong and weak samples; measurements of given absolute activity and specific activity; selection of instruments for required sensitivity.

#### Course No. 74: Friday, 8:30-10:00 A.M.

##### Instrumentation for Clinical Radiological Physics

C. S. SIMONS, Ph.D., Ann Arbor, Mich.

To be discussed in this course are: (1) the use, design, and construction details of several treatment-planning instruments, including a semi-automatic isodose-curve tracer; (2) localization technics which utilize orthogonal filming with and without a head-holder; (3) an inexpensive method of film "demagnification" for use in the dosimetry of radium cases.



## ANNOUNCEMENTS AND BOOK REVIEWS

### SECTION ON RADIOLOGY, MEDICAL SOCIETY OF DISTRICT OF COLUMBIA

Newly elected officers of the Section on Radiology of the Medical Society of the District of Columbia are: John S. Hashim, M.D., Chairman; Alfred A. J. Den, M.D., Chairman-Elect; William E. Sheely, M.D., 1746 K Street, N.W., Washington, D. C., Secretary-Treasurer; Albert Miele, M.D., Councilor to the American College of Radiology; George Tievsky, M.D., Alternate Councilor.

### RADIOLOGICAL SOCIETY OF HAWAII

J. C. Wang, M.D., of Honolulu is the recently elected President of the Radiological Society of Hawaii. Other officers are: P. S. Arthur, M.D., Vice-President, and G. J. Liese, M.D., Queens Hospital, Honolulu 8, Secretary-Treasurer. The Society meets on the third Monday of each month at 7:30 P.M., at a location designated by the secretary.

### LOS ANGELES RADIOLOGICAL SOCIETY

The Los Angeles Radiological Society has elected the following officers for 1961-62: President, Robert B. Engle, M.D.; Vice-President, Denis C. Adler, M.D.; Treasurer, Walter L. Stilson, M.D.; Secretary, Saul Heiser, M.D., 3701 Stocker St., Los Angeles 8; Member of the Executive Committee, Robert E. Rickenberg, M.D.; Councilor to the American College of Radiology, John H. Woodruff, M.D., Torrance; Alternate Councilor, Putnam C. Kennedy, M.D., Glendale. The Society meets the second Wednesday of September, November, January, March, and June in the Los Angeles County Medical Association Building.

The fourteenth Annual Midwinter Radiological Conference, sponsored by the Los Angeles Radiological Society, will be held at the Biltmore Hotel, Los Angeles, Calif., on Saturday and Sunday, Feb. 3-4, 1962.

An outstanding program of pertinent interest has been arranged. Guest speakers will be Dr. David Sutton, Saint Mary's Hospital, London, England; Dr. Scott Dunbar, Montreal Children's Hospital, Montreal, Canada; Dr. Richard Marshak, Mt. Sinai Hospital, New York, N. Y.; Dr. Gilbert Fletcher, M. D. Anderson Hospital, Houston, Texas; and Dr. Henry Kaplan, Stanford Medical Center, Palo Alto, Calif.

The Conference fee of \$25.00 includes two luncheon meetings featuring questions and answers. A banquet (\$7.50 per plate) preceded by cocktails will be held Saturday evening at the Biltmore Bowl. Reservations may be made through Victor G. Mikity, M.D., 2010 Wilshire Blvd., Los Angeles 57, Calif.

Courtesy cards will be available to residents in radiology and to radiologists in the Armed Forces by advance registration, with reduced tariff for the luncheons and banquet. Hotel reservations should be made promptly through the Convention Manager, Biltmore Hotel, Los Angeles.

### NORTHWESTERN OHIO RADIOLOGICAL SOCIETY

The newly formed Northwestern Ohio Radiological Society has elected the following, all of Toledo, as its officers: President, M. M. Thompson, Jr., M.D.; Vice-President, Robert P. Ulrich, M.D.; Secretary-Treasurer, George Asahina, M.D., 421 Michigan St., Toledo.

### TORONTO RADIOLOGICAL SOCIETY

At a recent meeting of the Toronto Radiological Society, the following were elected to serve for the ensuing year: President, Cyril Rotenberg, M.D.; Vice-President, Burton C. Prior, M.D.; Secretary-Treasurer, Wallace M. Roy, M.D., St. Joseph's Hospital, 30 The Queensway, Toronto 3, Ont., Canada.

### SECOND INTERNATIONAL CONGRESS OF RADIATION RESEARCH

The Second International Congress of Radiation Research will be held in Harrogate, England, Aug. 6-11, 1962. The Congress will be concerned with research into the physical, chemical, and biological effects of ionizing radiation. The Radiation Research Society, in co-operation with the National Academy of Sciences-National Research Council, is exploring possibilities for providing partial support to qualified participants. Applications must be submitted prior to Feb. 1, 1962. Forms for this purpose are available from the Committee on Travel Grants, Room 319, 2101 Constitution Avenue, N.W., Washington 25, D. C. Further information about the Congress may be obtained from the Secretary General, Dr. Alma Howard, Mount Vernon Hospital, Northwood, Middlesex, England.

### COLUMBIA UNIVERSITY SYMPOSIUM: BASIC PROBLEMS IN NEOPLASTIC DISEASE

Columbia University College of Physicians and Surgeons is sponsoring a three-day symposium on "Basic Problems in Neoplastic Disease," to be held March 12-14, 1962, to commemorate the fiftieth anniversary of the Institute of Cancer Research at Columbia University and the tenth anniversary of



its affiliated clinical facility, the Francis Delafield Hospital. An outstanding group of scientists from the United States and abroad will participate in the sessions.

The symposium is open without fee to all interested workers in this field. Details concerning the meeting, including applications, may be obtained from the Institute for Cancer Research, Columbia University College of Physicians and Surgeons, 630 West 168th St., New York 32, N. Y.

#### RADIOTHERAPY TRAINING PROGRAM STANFORD UNIVERSITY SCHOOL OF MEDICINE

The Department of Radiology, Stanford University School of Medicine, announces the inauguration of a new program for the training of radiotherapists, radiologic physicists, dosimetrists, and technicians. Residencies are available for straight radiation therapy training commencing July 1, 1962. The basic program covers three years, with an optional fourth year, which may be taken at another institution. Inquiries should be addressed to: Henry S. Kaplan, M.D., Department of Radiology, Stanford Medical Center, 300 Pasteur Drive, Palo Alto, Calif.

#### SPECIAL PROGRAM FOR RESEARCH GRANTS IN RADIOLOGICAL HEALTH

In view of the rapid expansion which is forecast in the use of nuclear energy, x-rays, and other sources of radiation, a greatly expanded program for research grants in the field of radiological health has been developed by the U. S. Public Health Service. These grants are offered to support research by individuals, universities, hospitals, laboratories, and other public or private institutions in the assessment and control of man-made and natural radiation exposures to the individual, no matter how the separate components may originate.

Further information and/or application forms may be obtained from Dr. Paul F. Hahn, Chief, Office of Extramural Grants, Division of Radiological Health, U. S. Public Health Service, Washington 25, D. C.

### In Memoriam

ARTHUR B. MCGLOTHLAN, M.D.  
1873-1961

Dr. Arthur B. McGlothlan, who for over forty years practiced Radiology in St. Joseph, Missouri, died in that city at the age of eighty-eight, on Aug. 14. Dr. McGlothlan was born in Hopkins, Mo., and was graduated from Washington University, St. Louis. He was on the staff of the Sisters' and Methodist Hospitals of St. Joseph.

Having retired from active practice in 1953, Dr. McGlothlan had since devoted much time to the study of history and archaeology. He was a fellow of the American College of Radiology and a member of the Radiological Society of North America, the American Radium Society, and the Association of American Physicians and Surgeons. Surviving is his widow, the former Anna Fakes, whom he married in 1908.

### Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

**GOLDEN'S DIAGNOSTIC ROENTGENOLOGY.** LAURENCE L. ROBEINS, M.D., Editor, Associate Clinical Professor of Radiology, Harvard Medical School; Radiologist-in-Chief, Massachusetts General Hospital, Boston, Mass. Renewal pages for Vols. I-III, including: Uterotubography, by Samuel A. Robins, M.D.; The Use of the Roentgen Ray in Obstetrics, by Howard C. Moloy, M.D., and Paul C. Swenson, M.D.; The Abdomen, by Juan M. Taveras, M.D., and Ross Golden, M.D.; Pediatric Radiology, by Lawrence A. Davis, M.D.; Soft Tissue Roentgenography, by Laurence L. Robbins, M.D., and Joseph Hanelin, M.D.; New Index Pages. Loose-leaf renewal pages 9.1-9.70; 10.1-10.119; 14.1-14.173; 15.1-15.176; 16.1-16.95. Published by Williams & Wilkins Company, Baltimore 2, Md., 1961. Price \$18.00.

**CANCER PROGNOSIS MANUAL.** By ARTHUR G. JAMES, M.D., F.A.C.S., Associate Professor, Department of Surgery and Oncology; Director of Columbus Cancer Clinic; School of Medicine, Ohio State University Medical Center, Columbus, Ohio. A manual of 74 pages. Published by the American Cancer Society, Inc., 521 W. 57th Street, New York 19, N. Y., 1961.

**THE YEAR BOOK OF CANCER (1960-1961 YEAR BOOK SERIES).** Compiled and edited by RANDOLPH LEE CLARK, JR., B.S., M.D., M.Sc. (Surgery), D.Sc. (Hon.), Houston, Texas; Director and Surgeon-in-Chief, The University of Texas M. D. Anderson Hospital and Tumor Institute; Professor of Surgery, The University of Texas Postgraduate School of Medicine; Clinical Professor of Surgery, Baylor University College of Medicine; Chairman, Committee on Cancer, American College of Surgeons; F.A.C.S., and RUSSELL W. CUMLEY, B.A., M.A., Ph.D., Houston, Texas; Director of Publications, The University of Texas M. D. Anderson Hospital

and Tumor Institute; Professor of Medical Journalism, The University of Texas Postgraduate School of Medicine; Executive Editor, Medical Arts Publishing Foundation. A volume of 540 pages, with 189 figures. Published by Year Book Medical Publishers, Inc., 200 East Illinois St., Chicago 11, Ill., 1961. Price \$8.50.

ONSETS, COMPLETIONS, AND SPANS OF THE OSSEOUS STAGE OF DEVELOPMENT IN REPRESENTATIVE BONE GROWTH CENTERS OF THE EXTREMITIES. By S. IDELL PYLE, HAROLD C. STUART, JOAN CORNONI, and ROBERT B. REED, Harvard University School of Public Health. Monographs of the Society for Research in Child Development, Vol. 26, No. 1, Serial No. 79, 1961. A brochure of 126 pages, with 46 figures and 10 tables. Published by Society for Research in Child Development, Inc., Purdue University, Lafayette, Ind., 1961. Price \$3.25.

## Book Reviews

### ROENTGENOLOGY OF INTRACRANIAL MENINGIOMAS.

By SIDNEY P. TRAUB, M.D., Associate Professor of Radiology, University of Saskatchewan College of Medicine; Assistant Director of Radiology, University Hospital, Saskatoon, Canada; Honorary Consultant Radiologist, Saskatchewan Cancer Commission; Formerly, Fellow in Neuro-radiology, Montreal Neurological Institute, Montreal, Canada. With an Introduction by Donald L. McRae, Montreal Neurological Institute, Montreal, Canada. A volume of 238 pages, with 128 figures. Published by Charles C Thomas, Springfield, Ill., 1961. Price \$14.00.

The author presents a study of the radiological aspects of meningeal tumors based on a large series from the Montreal Neurological Institute. Particular stress is placed on the plain film findings, since 88 per cent of such examinations showed important changes, and 35 per cent showed specific changes which suggested meningioma. In addition, there are chapters on pneumoencephalography and angiography. Early diagnosis is emphasized, as early surgical removal, before brain involvement, can result in cure. A very important chapter is that devoted to a review of the various forms of meningiomas with a summary of the roentgenologic and clinical features. A short chapter on the pathologic aspects is included.

This interesting text brings together the available information on the subject in a readable authoritative manner. Twenty-two tables and 273 well chosen roentgenograms and sketches add to its usefulness. The work should be of value to all who are concerned with this subject.

IXTH INTERNATIONAL CONGRESS OF RADIOLOGY, JULY 23-30, 1959, MÜNCHEN. ABHANDLUNGEN—TRANSACTIONS—TRAITÉS—ACTAS. Edited by PROF. DR. B. RAJEWSKY, Dr. phil. nat., Dr. med. h.c., Dr. med. h.c., Frankfurt a. M., Präsident des Kongresses. Editorial Committee: Prof. Dr. J. Becker, Heidelberg, Prof. Dr. R. Glanzer, Stuttgart, Prof. Dr. H. Langendorff, Freiburg, Br., Prof. Dr. H. Meyer, Marburg/L., Prof. Dr. H. Muth, Homburg/Saar. Secretary to the Editorial Committee: Prof. Dr. F. J. Strnad, Frankfurt a. M. Two volumes of 1,626 pages in all, with 1,008 figures. Published by Georg Thieme, Stuttgart, Germany, in co-operation with Urban & Schwarzenberg, Munich and Berlin, Germany, 1961. Distributed in the United States and Canada by the Intercontinental Medical Book Corporation, New York 16, N. Y. Price DM 240.—(\$60.00).

Through the co-operation of two well known German publishing houses, there have become available the transactions of the Ninth International Congress of Radiology, held in Munich in July 1959. The two volumes, produced under the direction of Professor B. Rajewsky, the President of the Congress, contain accounts of the official meetings as well as the many articles which were read in the scientific sessions, with their illustrations. Each paper is published in the language in which it was presented. As would be expected, a wealth of information on all phases of radiology is contained in these volumes.

SEMEIOTICA STRUMENTALE DELLE VIE BILIARI. By A. INFRAZZI, G. ESPOSITO, and S. DI GAETA. Foreword by Prof. Ettore Ruggieri. Preface by Prof. Pierre Mallet-Guy. A volume of 518 pages, with 250 figures. Published by Minerva medica, Turin, Italy, 1959.

This book describes in detail the many techniques employed in the evaluation of the liver and of the biliary system. Many of these are of great physiological and clinical interest. Some are of limited usefulness clinically, and others involve enough danger to be employed only by the more courageous investigators. In the Preface, Professor Mallet-Guy laments the fact that, while new methods were being developed and used in Latin America and in Latin Europe, North American investigators have shown a comparative lack of interest. A criticism of such a general nature is difficult to answer. It is quite possible that our estimates of the time, cost, meaning, reliability, and danger of some methods may have been such that these have not become popular in our country. On the other hand, all methods which have proved

to be accurate and danger-free are employed widely in America as well as abroad.

The book begins with a description of classical duodenal drainage and the separation of the bile collected. This test, which is still in general use everywhere, has been modified by many authors by adding the study of time factors, by the study of excretion of various substances, by combination with the radiologic study of the opacified gallbladder, and the radiologic study of the duodenum through the injection of barium into the drainage tube.

The second part of the book describes the techniques and results of the radiologic study of the gallbladder and bile ducts alone and in combination with the radiologic study of the duodenum. Special attention is given to the measurement of the area of the gallbladder shadow in various phases, to the effects of various drugs on the biliary system, to the value of pneumoperitoneum, of laminagraphy, of plesioradiography, of roentgen cinematography, and of isotopic scanning of the liver and of the gallbladder.

In the third part of the book the various percutaneous operative technics are described, as liver biopsy, peritoneoscopic needle puncture of the gallbladder, transhepatic needling of the bile ducts and other similar procedures. The fourth part deals with the operative and postoperative study of the biliary system, including surgical-radiological studies of the gallbladder and bile ducts as well as the various types of manometric studies. Of interest is the description of several special surgical-radiologic installations and of the surgical instruments designed for these purposes.

The book is well written, well organized, well printed, and well illustrated. The methods of study should be of special interest to the physiologically inclined gastroenterologist. The chapter on radiological methods describes in detail some procedures which may be of help in difficult diagnostic problems. As a whole, this is an excellent work, both for the thoroughness with which the authors have collected the available material and the integrated fashion in which they have succeeded in presenting it.



## ABSTRACTS OF CURRENT LITERATURE

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## ROENTGEN DIAGNOSIS

### THE HEAD AND NECK

**Brachial Cerebral Angiography.** Robert A. Kuhn. *J. Neurosurg.* 17: 955-971, November 1960. (All Souls Hospital, Morristown, N. J.)

Total survey of the cerebral vascular tree from its thoracic roots upward appears to be indicated in all patients with signs or symptoms of cerebral ischemia suspected to be caused by cerebrovascular disease. Brachial angiography is a useful means to this end. Following one retrograde injection of the brachial artery, two-thirds of the total cerebral circulation becomes opacified sequentially.

A cut-down on the brachial artery is performed for cannulation, and two 30-c.c. injections of 50 per cent diatrizoate sodium (Hypaque) are made, one for the anteroposterior sequence of the radiographic examination and one for the lateral sequence. Both the Sanchez-Perez and Elema-Schönander film changers have been found satisfactory. With the latter, the anteroposterior series is usually taken with a sequence of three films in the first second, two in the second, a three-to-four-second pause, and three final pictures at intervals of one and a half seconds. Barring unusual delays, the entire procedure takes about an hour. There has been no morbidity or mortality in a series of over 200 adults and children in whom the method has been employed.

Numerous advantages of brachial angiography are cited, along with recitation of the many possible hazards of and adverse effects from percutaneous carotid, vertebral, and subclavian artery injections. In the opinion of the author, brachial angiography is preferable for demonstrating segmental arterial disease in the neck. It produces only slight operative trauma, and the patient experiences far less discomfort than with percutaneous cervical puncture.

Eighteen roentgenograms; 1 photograph.

DON E. MATTHESEN, M.D.  
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**Combined Carotid-Vertebral Angiography—A Method of Vertebral Angiography. A Selective Procedure—Preliminary Report.** M. E. Berk. *Brit. J. Radiol.* 33: 780-783, December 1960. (Johannesburg General Hospital, Johannesburg, Union of South Africa)

The author describes a technic for combined carotid-vertebral angiography. The principle involved is based upon the anatomical division of the innominate artery, on the right side, into the right subclavian and the right common carotid arteries. This enables a catheter to be placed at the origins of both the right carotid system and also the right subclavian and therefore the right vertebral system.

A Seldinger catheter is passed down the right common carotid artery for 1 to 1 1/2 inches so that the tip lies above the innominate artery. Twenty cubic centimeters of 60 per cent Urografin is injected by hand as rapidly as possible into the catheter. Approximately half of the contrast medium passes down the subclavian and half up the carotid artery. The timing of the exposures varies with the portion of the arterial system to be studied. The author commences with a lateral projection to obtain a general view of both systems; this is followed by a submento-vertical projection.

The method provides simultaneous opacification of the carotid and vertebral systems. It is an easy, reliable means of visualizing the right vertebral artery, especially from its origin. With the catheter in position, the patient may be moved without risk of its displacement. Selective angiography may be carried out. The method appears ideal in children for demonstration of the vertebral as well as the carotid system. Theoretically one should be able to visualize all of the circle of Willis, using a long exposure of about two seconds with compression of the left common carotid. This has been attempted in a limited number of cases with moderate success.

The procedure has the disadvantage that only the right side may be visualized in this way. The possibility of catheterizing the left common carotid with an acutely angled catheter having multiple perforations is being investigated.

Combined carotid-vertebral angiography is indicated in unexplained subarachnoid hemorrhage with no localizing signs, in carotid-basilar deficiency syndromes, and in tumors deriving their blood supply from both vertebral and carotid systems. Unsuspected anomalies such as aberrant right subclavian artery may be shown by this technic.

Seven roentgenograms.

THEODORE E. KEATS, M.D.  
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**Subarachnoid Hemorrhage in Meningioma of the Lateral Ventricle.** Harden M. Askenasy and Albert D. Behmoaram. *Neurology* 10: 484-489, May 1960. (Beilinson Medical Center, Petah Tikva, Israel)

Meningiomas growing within the lateral ventricle of the brain are rather rare, only about 70 cases having been recorded. Of 7 patients with intraventricular meningioma operated upon by the authors, 2 at first were erroneously believed to have ruptured cerebral aneurysms because of the acute onset of their illnesses with severe subarachnoid hemorrhage. These 2 cases are reported in detail.

Both patients were women, thirty-four and thirty-eight years of age, respectively. In the first, arteriography showed a displacement upward of the sylvian group of arteries which was thought to result either from hemorrhage in the middle and posterior temporal lobe from a ruptured aneurysm of the posterior communicating artery, which was not visualized, or from localized brain edema. A correct diagnosis might have been made in this case on the strength of radiologic and angiographic findings, had it not been for the acute onset of the severe subarachnoid hemorrhage with no history of any previous symptoms. This led to a search for a vascular malformation only. Carotid angiography was performed in the second patient while her condition was still serious because intracerebral hemorrhage due to rupture of an aneurysm within the left temporal lobe was suspected. It was felt that no improvement could be expected unless the suspected blood clot was evacuated without delay. Brain tumor was diagnosed correctly only after cerebral angiograms showed changes of the vascular pattern described as consistent with the diagnosis of intraventricular meningioma (Huang and Araki. *J. Neurosurg.* 11: 337, 1954. *Abst. in Radiology* 64: 756, 1955).

The occurrence of subarachnoid hemorrhage in 2 of

7 patients with intraventricular meningioma is clinically significant and furnishes an additional argument for carrying out angiography in patients with subarachnoid bleeding. The mechanism of the hemorrhage is discussed.

Six roentgenograms; 2 photographs

**Correlation of Neurologic Syndromes with Lesions Found Angiographically. Report of 6 Cases of Cerebral Arterial Insufficiency.** William S. Fields, Paul C. Sharkey, E. Stanley Crawford, and George C. Morris. *Neurology* 10: 431-438, May 1960. (Baylor University College of Medicine, Houston, Texas)

In view of the accumulating evidence that many strokes are due to extracranial occlusive disease, it has become increasingly necessary to employ precise methods for localization of lesions. Even though the clinical findings may suggest that the lesion is in the carotid system, it is often difficult to distinguish between intracranial and extracranial lesions. The same difficulty exists in distinguishing between vertebral and basilar occlusive lesions. These considerations are particularly important when one is trying to determine whether an atheromatous lesion can be attacked surgically.

The authors report 6 illustrative cases to demonstrate the difficulty of clinically localizing lesions without benefit of information obtainable only by arteriography. These 6 cases were selected from among more than 300 of suspected occlusive cerebrovascular disease in which angiographic studies were carried out. All procedures were performed under local anesthesia; the contrast medium was Hypaque. No fatalities occurred in this series; 1 patient had hemiparesis that lasted twenty-four hours and 3 others had focal seizures during the examination with no residual deficit.

It is the opinion of the authors that cerebral arteriography carries no increased risk in the presence of atherosclerosis if reasonable caution is used and the procedure is performed under local anesthesia to avoid hypotension. With the employment of the more refined techniques and the introduction of newer contrast media, the frequency with which complications are encountered in arteriographic examination in general has been greatly reduced in the past three years.

Eighteen roentgenograms; 9 drawings.

**Papilloma of the Choroid Plexus in Childhood.**

Donald D. Matson and Francis D. L. Crofton. *J. Neurosurg.* 17: 1002-1027, November 1960. (D. D. M., 300 Longwood Ave., Boston, Mass.)

This review of cases of choroid plexus papilloma in children appeared in *Am. J. Roentgenol.* (Crofton and Matson: 84: 479, 1960. *Abst. in Radiology* 77: 311, 1961). The present paper adds protocols of the 16 cases.

Thirteen figures, including 6 roentgenograms

**Vagal-Body Tumor (Chemodectoma of the Glomus Intra-vagale).** Patricio E. Perez, Edgar G. Harrison, Jr., and William H. ReMine. *New England J. Med.* 263: 1116-1121, Dec. 1, 1960. (The Mayo Clinic, Rochester, Minn.)

Chemodectoma (nonchromaffin paraganglioma) is a rare cause of a mass presenting in the anterolateral aspect of the neck. Such a tumor may arise from any of several morphologically similar nests of cells known as chemoreceptors, including the well known carotid

body, the vagal body, and the glomera along the cervical portion of the vagus nerve. In addition, a tumor of the glomus jugulare complex occasionally extends downward to involve the cervical structures.

"Vagal-body tumor" is the designation given by Birrell (Australian & New Zealand J. Surg. 23: 48, 1953) to a chemodectoma that originates from the chemoreceptor tissue of the vagal body. It is usually found just beneath the base of the skull and near the jugular foramen, attached to and often arising partially within the vagus nerve. Growth of the tumor as it follows the pathway of the vagus may eventuate in infiltration of the jugular foramen and the brain stem. It is important that vagal-body tumors be distinguished from chemodectomas of the glomus jugulare and carotid body because of important differences in their clinical behavior, surgical management, and prognosis. Patients with glomus jugulare tumors usually have a history of increasing deafness, chronic recurrent aural discharge, symptoms of cranial-nerve involvement, and a polypoid mass in the aural canal. A chemodectoma of the carotid body presents most frequently as a mass at the level of the carotid bifurcation. Carotid angiography is used to differentiate carotid-body tumor, vagal-body tumor, and carotid aneurysm. Carotid-body tumors usually widen the carotid bifurcation and displace the common carotid laterally; irregular vessels may be seen extending from the internal and external carotid arteries into the tumor. Characteristically, in vagal-body tumors, there are displacement of the internal carotid artery without widening of the carotid bifurcation and possibly increased vascularity of the tumor. Roentgen studies of the skull are suggested to disclose widening of the foramen jugulare or damage to bony structures.

Two cases of vagal-body tumor are reported, and the findings in 18 verified cases from the literature are reviewed. In one of the authors' cases carotid arteriography was performed to rule out aneurysm and the picture typical of vagal-body tumor was obtained.

Complete resection was successful in 15 of the 20 patients. Early surgery is recommended in vagal-body tumor to prevent intracranial extension of the neoplasm through the foramen jugulare and subsequent compression of the brain stem.

Seven illustrations, including 1 roentgenogram.

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**Radiology in Stereotaxic Cerebral Surgery.** A. A. Donaldson and F. J. Gillingham. *Brit. J. Radiol.* 33: 757-760, December 1960. (Royal Infirmary, Edinburgh, Scotland)

The apparatus used by the authors for stereotaxic cerebral surgery was originated by Guiot of Paris and considerably modified by Gillingham. It consists of a graduated sagittal bar which is fixed to the skull by screws at three points. Attached to this is a removable cursor consisting of a transverse bar carrying adjustable sights to which is tied the electrode carrier. The principle underlying the use of the instrument is briefly that one dimension, namely the parasagittal axis, is fixed preoperatively, and the other two axes are determined and adjusted under direct vision at the operation. The operative and radiological techniques have been gradually evolved and improved over a period of three years and it is felt that they have now reached a definitive stage. The procedure, which is carried out in two

stages, is described in detail. The results in the first 60 patients are summarized. Most of this group were suffering from parkinsonism, but the technic has been applied to the treatment of other dyskinesias, intracranial pain, and for prefrontal leukotomy.

Three roentgenograms; 1 photograph.

THEODORE E. KEATS, M.D.  
University of Missouri

**Radiology in Stereotaxis.** Lawrence S. Walsh. *Brit. J. Radiol.* 33: 761-764, December 1960. (St. George's Hospital, London, S. W. 1, England)

The author has been using Leksell's stereotactic instrument in the treatment of parkinsonism and other conditions characterized by involuntary movements and disturbances of tone, and also for the implantation of radioactive gold grains into tumors which are fairly well localized and deeply situated. The instrument consists of a square frame, which is rigidly fixed to the patient's head by means of three drills which penetrate the skull. The technic is described in detail, including that for the implantation of the gold grains.

About 100 patients with parkinsonism have now been treated by this technic. Early in the series a so-called pallidal lesion was made, but in the more recent cases the target has been the thalamus. Speech disturbance, difficulty in swallowing, and oculogyric crises are not usually affected by operation; it is the rigidity, tremor, and slowness of movement of the limbs which are improved. The complications associated with the procedure are discussed.

One table. THEODORE E. KEATS, M.D.  
University of Missouri

**Stereotactic Diagnosis and Radioactive Treatment in a Case of Spheno-Occipital Chordoma.** L. Zoltán and I. Fényes. *J. Neurosurg.* 17: 888-900, September 1960. (Institute of Neurosurgery, Budapest, Hungary)

Chordoma, a rare tumor, may occur at any site along the notochord. Over 80 per cent are seen at the cranial and sacrococcygeal ends. The greatest incidence of spheno-occipital chordoma is in the third and fourth decades, with the average age at onset being forty years. The average duration of life in patients with cranial nerve involvement is three to three and a half years from the time of the first symptoms.

The diagnosis heretofore has been made exclusively on a histologic basis after opening the skull or by evidence of tumor invasion of the nasopharynx. The symptoms produced by chordomas differ in no way from those of any other process in the same location. Roentgen changes caused by cranial chordoma cannot be differentiated from those of other neoplasms involving the base of the skull. Usually all that is seen is a bone-destroying lesion, mainly of the clivus, often invading the sphenoid bone as well. The roentgenogram may even be normal. Treatment has been operative, though complete surgical removal of the tumor is virtually impossible. There seems to be agreement that chordoma is almost uniformly radioresistant.

The authors report a case in which a stereotactic apparatus was employed to implant five radioactive yttrium-90 seeds (about 5-6 mc) within a malignant spheno-occipital chordoma. The instrument was inserted through a small surgical defect in the right nasal bone and was guided to the tumor site under "continual roentgen-ray control." Prior to the implantation, a biopsy specimen was obtained. Results were surpris-

ingly good. In eight days the patient was discharged from the hospital and in less than four weeks he was free of symptoms objectively and markedly improved subjectively. At the time of writing, nine months after the implantation of yttrium, he was completely symptom-free.

According to the authors, this is the first use of stereotactic puncture for the histologic diagnosis of an intracranial tumor. The procedure may also prove useful in the treatment of other types of tumor in the base of the skull.

Four roentgenograms; 1 photograph; 2 photomicrographs; 2 tables. DON E. MATTHIESEN, M.D.  
Phoenix, Ariz.

**Aid of the Radiologic Examination in the Differential Diagnosis of Exophthalmos.** G. J. Melot and R. Potvlieghe. *J. belge de radiol.* 43: 525-551, 1960. (In French) (Institut J. Bordet, Bruxelles, Belgium)

Over thirty causes of unilateral exophthalmos are tabulated in this article. Radiologic investigation provides valuable information for orientation or even precision in the diagnosis of the underlying conditions.

These are separated into orbital lesions proper, secondary orbital lesions, and lesions of the orbital orifices (optic canal and sphenoidal fissure). The most common causes of unilateral exophthalmos include mucocele, cellulitis or abscess, cancer of the paranasal sinuses, and meningioma.

Three tables and seventeen radiographic reproductions add to the interest of the discussion.

CHARLES M. NICE, JR., M.D., Ph.D.  
Tulane University

**Unilateral Exophthalmos. Report of a Case with Demonstration of an Intraorbital Tumor by Orbital Pneumotomography.** Sylvia S. Bottomley, Leonard W. Jarcho, David W. Stowell, and J. Garth Chatterley. *Arch. Ophthalmol.* 64: 438-442, September 1960. (VA Hospital, Salt Lake City 13, Utah)

Several writers (see, for example, Dubilier *et al.* *Radiology* 66: 387, 1956) have reported the use of orbital pneumotomography for the demonstration of intraorbital tumors. The present authors employed the procedure in a patient with unilateral exophthalmos.

A 27-year-old man gave a history of slowly progressive left exophthalmos, probably starting at about the age of fifteen. For three months he had noticed aching and a pressure sensation in the left eye after prolonged reading or in bright light. Examination showed that the anterior pole of the left eye projected 5 mm. further forward than the right, but the eye was normal in all other respects. The thyroid gland was not palpable, and there were no signs of hypermetabolism. Roentgen examination of the skull, including orbital views, disclosed no abnormalities. Pneumotomography revealed a rounded (2 x 2.5-cm.) soft-tissue mass, well outlined by the gas. Essentially it filled the superior lateral quadrant of the retrobulbar space. Since hemangioma was one of the diagnostic possibilities considered, left carotid arteriography was performed; this failed to show abnormal vascular channels within the left orbit. At operation, an intraorbital tumor was excised and proved to be a cavernous hemangioma. Five months postoperatively, there was minimal diplopia on extreme lateral gaze; there were no other visual complaints, and the exophthalmos had disappeared.

Two roentgenograms; 4 photographs.



**A Röntgen Reference Contact Lens, Fixed by Low Vacuum.** J. G. F. Worst. *J. belge de radiol.* 43: 591-597, 1960. (In English) (University Eye Clinic, Groningen, Holland)

To localize foreign bodies, a glass contact lens has been developed with a radiopaque limbal ring of 12 mm. diameter. The glass has a conically shaped handle. A central boring is connected to a rubber suction cap by means of flexible polythene tubing. The contact lens is applied to the anesthetized eye, after which slight pressure and subsequent release of the rubber cap permits firm suction. The lens will automatically assume a central position, due to the apposition of the curves of the glass to those of the eye, and displacement because of eye movements is eliminated. The conical handle, with the steel capillary jutting out from it, forms a clearly visible pointer in the sagittal axis of the eye and helps to ascertain whether the patient is looking perpendicular or parallel to the film.

For the purpose of determining the spatial relations of the foreign body to the eye a special transparent Comberg reference scheme has been devised. The scheme can be applied directly to the roentgenogram, as it has been made life size, but with a correction for magnification.

With this system, foreign bodies have been successfully localized in 20 cases in the Groningen Eye Clinic.

This device is described also in a paper in the American literature (Worst, J. G. F., and Otter, K.: *Am. J. Ophth.* 51: 410-424, March 1961) with a discussion of its use in the bone-free technic of Vogt in localization of minute foreign bodies in the anterior portion of the eye, and for other ophthalmologic studies.

Nine figures, including 4 roentgenograms.

CHARLES M. NICE, JR., M.D., Ph.D.  
Tulane University

**A Roentgenographic and Clinical Study of the Larynx and Pharynx.** R. Sheehan, F. Lessmann, F. Marchetta, and R. K. Lin. *Surg., Gynec. & Obst.* 111: 753-758, December 1960. (Roswell Park Memorial Institute, Buffalo, N. Y.)

The value of roentgenologic examination of the larynx and pharynx was appraised in 60 patients with suspected neoplasms in these regions. All had the benefit of soft-tissue studies of the neck and laminagraphic studies of the larynx. In 46 cases, a diagnosis of neoplasm was confirmed.

In 30 of the 60 patients, the clinical and roentgenographic findings corresponded with the laminagraphic findings as to the presence or absence of a lesion, and no additional information was contributed. Eight patients had benign lesions; in 4 of these the laminagraphs were negative, and in 4 the presence of edema indirectly suggested a pathologic process. In 18 patients, laminagraphy did provide additional information: In 2, it revealed laryngoceles not detected clinically; in 16, areas not visualized at laryngoscopy were demonstrated, showing them to be normal or the site of inferior extension not evident clinically. The roentgen findings failed to correspond with the clinical findings in only 4 cases, in 3 of these because of unsatisfactory laminagraphs. In the fourth, an incorrect laminagraphic diagnosis of a lesion of the false cord was made.

If the tumor originated or extended beyond the cords in the larynx, it was often technically impossible for the laryngoscopist to see beyond the lesion, and the

true condition of the cords or the subglottic region could not be determined. Laminagraphs were very helpful in demonstrating these unseen areas. Laminagraphy was sometimes valuable in large tumors of the pharynx which extended into the endolarynx and obscured the clinician's view of the cords. In neoplasms confined chiefly to the region of the cords, the main value of laminagraphs was in demonstrating the subglottic extension. In cases in which no neoplasm was found, little additional information was obtained. A lateral view of the neck permits an evaluation of the extension of the lesion in respect to its depth or height.

Eight roentgenograms.

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University of Pennsylvania

**Cricopharyngeal Dysphagia.** John Hampton. *Am. J. Roentgenol.* 84: 1028-1036, December 1960. (104 Doctors Bldg., Chattanooga 3, Tenn.)

The author reviews the literature on the anatomy and physiology of the cricopharyngeus muscle. According to Palmer (*The Esophagus and Its Diseases*, 1952), "The laryngopharyngeus muscle arises as two bilaterally symmetrical sheets from the lateral aspects of the cricoid and thyroid cartilages and sweeps dorsally, fanning cephalad to insert with its opposite mate into the dorsal fibrous raphe of the pharynx. The cricopharyngeus is the caudad part of the preceding muscle. It takes its insertion bilaterally from the posterolateral aspect of the cricoid cartilage and passes dorsally to encircle the junction of the hypo-pharynx and esophagus. Its upper fascicles insert dorsally into the posterior pharyngeal raphe, but the lower ones are continuous across the midline." It is thought that the vagus is the relaxor and the sympathetic the contractor of the cricopharyngeus. The cricopharyngeus remains in contraction when the inferior constrictor and muscles of the upper esophagus are relaxed. But when there is prolonged irritation of the lower pharynx or upper end of the esophagus by a foreign body, neoplasm, inflammation, or ulceration, initial swallowing efforts to dislodge the cause of irritation are succeeded by absence of relaxation or achalasia.

Roentgenography is the sole objective means of diagnosing cricopharyngeal dysphagia. In the lateral view the contracted cricopharyngeus muscle produces a convex, smooth indentation in the barium column posteriorly at the level of the C5-C6 interspace. Osteophytes from the cervical spine may also indent the barium column, but the etiology of the defect so produced is obvious. Sideropenic webs or constrictions are usually located anteriorly and are smaller than the muscle. Neoplasms and foreign bodies should not cause confusion unless secondary spasm of the muscle occurs. In the anteroposterior view, a horizontal band about 0.5 cm. in width and about 2 cm. long spans the pharyngo-esophageal junction. A partial obstruction caused by dysfunction of the cricopharyngeus muscle may produce hyperperistaltic waves in the laryngopharyngeus muscle which can be confused with a mass.

In the author's experience, satisfactory roentgenograms of the pharyngo-esophageal area filled with barium were more readily obtained than during the performance of the Valsalva maneuver. The author prefers roentgenograms made with the Bucky diaphragm and overhead tube to spot films. The exposure factors employed were 100 ma, 120 kv, 0.1 second, and a grid ratio of 16 to 1. A filter of 2 mm. Al and a cone

are used. Anteroposterior and lateral views are obtained as the patient swallows a thick barium suspension.

A search of the literature for articles concerning cricopharyngeal dysphagia proved rather frustrating. The clinical significance of the roentgenographic characteristics of the cricopharyngeus muscle is belittled by some and emphasized by others.

Two cases are reported which were diagnosed as cricopharyngeal dysphagia. A three-year follow-up of one patient showed the development of a pharyngeal diverticulum in an unusual location. The other patient improved both clinically and roentgenographically following dilatation of the cricopharyngeus muscle.

Fourteen roentgenograms.

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### THE CHEST

**Toxicity of Bronchographic Contrast Media. An Experimental Investigation.** Philip M. Johnson, Walter R. Benson, William H. Sprunt, III, and William A. Dunnagan. *Ann. Otol., Rhin. & Laryng.* 69: 1102-1113, December 1960. (P. M. J., 141 Central Ave., Montclair, N. J.)

An investigation was undertaken to determine the relative toxicity of 8 commonly used bronchographic contrast media. These included the commercial media Iodochlorol, Dionosil Oily, Lipiodol, and Visciodol and the experimental modifications, Iodochlorol and tristearin, Iodochlorol and succinylsulfathiazole, Lipiodol and tristearin, and a barium sulfate-carboxymethylcellulose suspension.

Male and female adult rabbits were divided into eight groups of 12 each. One cubic centimeter of the contrast agent under study was injected directly into the trachea of each animal. Roentgenograms were taken within two to five minutes thereafter to verify entrance of the medium into the major bronchi on either side. The animals were sacrificed at two to one hundred and fifty days following injection. In each instance, the heart and lungs were removed *en bloc*. Prior to histologic study, both lungs of each animal were cut in sagittal sections; roentgenograms of these sections were made to demonstrate macroscopic amounts of residual contrast medium. Histologic sections were examined without knowledge of the medium employed and graded on a scale of 1 to 4 in increasing severity with regard to (1) septal exudate, (2) alveolar exudate, (3) abscess formation, (4) scarring, and (5) foreign material, lipid or otherwise. The histopathologic findings at five months following injection were then utilized to grade the toxicity of the contrast agents.

Lipiodol was found to be the least toxic compound. Only slightly more toxic were Visciodol, Iodochlorol-tristearin, and Iodochlorol alone. Iodochlorol-sulfasuxidine and Dionosil Oily were intermediate in toxicity. Lipiodol-tristearin produced a distinctly higher incidence of abnormal findings in the lungs than the compounds mentioned above. By far the most toxic medium was the barium sulfate-carboxymethylcellulose suspension. This last agent exhibited sufficient toxicity to warrant further investigation before recommendation of its use in man.

Four photomicrographs; 2 tables.

JAMES W. BARBER, M.D.  
Cheyenne, Wyo.

**Bronchography in Infantile Pneumopathies.** Alejandro A. Castro Franco. *Radiologia* 11: 37-39, December 1960. (In Spanish) (Lima, Peru)

The author reports 207 bronchographic studies performed in 171 children, of whom 45 were in the age group of three months to two years. Pulmonary tuberculosis was the most frequent abnormality encountered, suppurative pneumonitis the second, and bronchiectasis the third. Radiographically, the results were classified as excellent in 31 per cent, good in 48 per cent, acceptable in 10 per cent, and unsatisfactory in the remainder of the patients.

The high percentage of good results was attributed to careful preoperative and postoperative care, rectal administration of barbiturates to permit easy intubation, instillation of 0.25 per cent Pontocaine into the tracheobronchial tree, use of a good contrast medium (Propilodon Cilag), and the positioning technic employed.

Four tables.

DON E. MATTHIESEN, M.D.  
Phoenix, Ariz.

**Intrathoracic Manifestations of Malignant Lymphomatous Disease.** Archie H. Carmichael, Damon D. Blake, and John H. Felts. *Dis. of Chest* 38: 630-637, December 1960. (Bowman Gray School of Medicine, Winston-Salem, N. C.)

The possibility of malignant lymphoma is often overlooked in the differential diagnosis of pulmonary and mediastinal disease. In an attempt to delineate the clinical pattern in this condition, the authors reviewed 100 histologically proved cases selected at random from the files of the North Carolina Baptist Hospital. The series included 35 cases of Hodgkin's disease, 20 of lymphosarcoma, 26 of chronic lymphocytic leukemia, 12 of reticulum-cell sarcoma, and 7 of giant follicular lymphoma. The average duration of follow-up was twenty-two months. Fifty-five patients were men and 45 were women.

Pulmonary symptoms were infrequent despite a high incidence of intrathoracic involvement as indicated by chest roentgenograms. Nonproductive cough and dyspnea were the most common complaints but were rarely troublesome in the absence of infection or pleural effusion. Other symptoms encountered were chest pain, usually a nonspecific aching, choking, and hoarseness.

In 50 patients, the findings on the initial chest roentgenogram were suggestive of lymphoma; 4 more patients later had roentgen evidence of pulmonary disease. Hilar adenopathy was the most common finding, being present in 34 of the 54 patients with positive roentgenograms. Twenty-two patients exhibited enlargement of the paratracheal nodes as well. Parenchymal lesions were demonstrated in 23 (solitary nodules in 2, scattered nodular densities in 7, pneumonic infiltrative lesions in 10, and diffuse lymphatic dissemination in 4).

The most frequent finding on physical examination was peripheral lymphadenopathy, which was present in 73 patients—39 with positive and 34 with negative chest films. Splenomegaly was found in 47 patients, fever in 45, hepatomegaly in 30, anemia in 29, and eosinophilia in 16.

Intrathoracic lymphoma may mimic many benign and malignant lesions, including tuberculosis, carcinoma, sarcoidosis, "collagen" disease, tularemia, infectious mononucleosis, substernal goiter, dermoid cyst, thymoma and other mediastinal tumors. Conditions with intrathoracic manifestations and peripheral eosino-

philia which must be differentiated from lymphoma include Loeffler's syndrome, coccidioidomycosis, parasitic infestations, polyarteritis nodosa, and carcinoma.

The fact that in this series intrathoracic involvement was demonstrable in 54 per cent of the patients, and was more frequent than such well recognized features as hepatosplenomegaly, fever, anemia, and eosinophilia, emphasizes the importance of the routine chest film in diagnostic study. No clinical syndrome or roentgenographic pattern characteristic of any one of the types of malignant lymphoma was encountered.

Patients who presented positive roentgenographic signs on initial chest studies tended to have more diffusely disseminated disease and seemed to have a slightly poorer prognosis than those who were first seen with normal chest roentgenograms.

Three illustrative cases are reported.

Four roentgenograms; 4 tables.

WILLIAM H. ELLSWOOD, M.D.  
Charleston, W. Va.

**Solitary Coin Lesions of the Lung.** William O. Pischnotte and Billy P. Sammons. *J.A.M.A.* 173: 1532-1535, Aug. 6, 1960. (B. P. S., U. S. Naval Hospital, Pensacola, Fla.)

The asymptomatic patient with a solitary pulmonary lesion which has been discovered on routine chest roentgenography presents a difficult and urgent diagnostic problem because of the significant percentage among such lesions of malignant growths, tuberculoma, fibrocereous granuloma, and arteriovenous fistulas. Tomography, fluoroscopy, and angiocardiology may be helpful in arriving at a definitive diagnosis. The routine chest roentgenogram will sometimes show the presence of calcium in the lesion, a good but not an absolute sign of benignity; tomography is often required to visualize the smaller calcific deposits. Angiocardiology is the procedure of choice for demonstrating pulmonary arteriovenous fistulas and abnormalities of pulmonary vasculature produced by an encroaching neoplasm.

The authors report the results of a study of 95 asymptomatic patients with coin lesions. There were 86 males and 9 females in the series, with an average age of 32.2 years. The investigation was limited to solitary lesions, homogeneous or calcified, 1.0 to 4.5 cm. in diameter, round or oval in shape, with sharp borders surrounded by normal lung. The final diagnosis was based on histologic examination. In 6 cases the lesion proved to be malignant; in 55, a fibrocereous granuloma; in 14, a tuberculoma; and in 3, an arteriovenous fistula. None of the 6 malignant tumors showed any calcification. A tendency for the malignant lesions to occur in the older age group was noted, although 2 of the 6 patients with malignant tumors were thirty-two years of age.

As a result of the survey, the authors feel strengthened in their belief that all solitary pulmonary lesions should be excised and examined histologically.

One table.  
GENEVIEVE WELLBAUM, M.D.  
St. Vincent's Hospital, New York

**The Upper Lobe Lesion—Old or New, with Reference to a Case of Aspergillosis (Mycetoma).** Beatty H. Ramsay. *Dis. of Chest* 38: 625-629, December 1960. (2210 Santa Monica Blvd., Santa Monica, Calif.)

Routine or survey radiographs of the chest uncover two major groups of lesions, namely, the coin lesion and the upper lobe "scar." The author calls attention to the fact that apical scarring, in the form of linear

strands, nodular densities, pleural thickenings, and unchanging cavitation, is too often disregarded or attributed to healed tuberculosis. The chaos of fibrotic changes may obscure reactivation of old disease or the development of new conditions, such as neoplasm, fungus disease, etc.

Four selected cases with appropriate radiographs are presented to show the development of aspergillosis, active tuberculosis, reactivation of tuberculosis with extension of cavitation, and adenocarcinoma, respectively, in areas where "old" lesions existed.

It is emphasized that neither upper lobe "scars" of years duration, lack of complaints, absence of x-ray evidence of activity, nor any simple criterion can be relied upon as an index of inactive scarring. Careful comparison of all available radiographs, bacteriological study of sputum and gastric washings, intradermal testing, therapeutic trial with antibiotics, and pulmonary resection may be needed to diagnose these upper lobe lesions correctly.

Eight roentgenograms. WILLIAM H. ELLSWOOD, M.D.  
Charleston, W. Va.

**Skin Tumor as the Cause of Nodular Chest Density: Case Report.** E. P. Gelvin. *J. M. Soc. New Jersey* 57: 684-685, December 1960. (Bell Telephone Laboratories, Inc., Whippany, N. J.)

A nodular lesion at the level of the first left intercostal space, not shown on films a year previously, was demonstrated on a chest teleroentgenogram of a 58-year-old man. The finding disappeared after excision of an 8 × 5-mm. sessile skin growth on the left posterior thorax at about the level of the described density. The pathologic report was sclerosing hemangioma, skin of the back.

Two roentgenograms.

**Lung Abscesses Secondary to Adrenal Cortical Hormone Therapy.** H. Faust and W. Richter. *Fortschr. a. d. Geb. d. Röntgenstrahlen* 93: 713-720, December 1960. (In German) (Städt. Auguste-Victoria-Krankenhaus, Berlin-Schöneberg, Germany)

Corticosteroids are known to suppress inflammatory processes and to cause an almost asymptomatic course of bacterial infections. The drugs may also give rise to such complications as tissue necrosis and abscess formation.

Three cases are reported with intractable bronchial asthma and pulmonary emphysema. They were treated with Prednisone for prolonged periods of time. In all three a pneumonitis developed which resulted in secondary suppuration and abscess formation.

Continuous corticosteroid medication is indicated only as a last resort in the treatment of intractable bronchial asthma. It must always be given in combination with antibiotics. Contraindications are gastroduodenal ulcers, a tendency to thrombosis, and chronic bronchiectases with or without associated pneumonitis.

Periodic control roentgenograms are necessary to check for possible development of pulmonary infection, rendered asymptomatic by the steroid medication. The drug must be discontinued as soon as a consolidating process is discovered. It should be replaced by specific antibiotic medication after a causative organism is found in the sputum or in aspirated pus.

Fifteen roentgenograms. ERNEST KRAFT, M.D.  
Northport, M.D.

**Xeroderma Pigmentosum Blastomatosum Malignum with Pulmonary Metastasis.** Hellmuth Lack and Otto-Ludwig Handreke. *Strahlentherapie* 113: 264-271, October 1960. (In German) (Rudolf-Virchow-Krankenhaus-Berlin, Germany)

Xeroderma pigmentosum, first described by Kaposi in 1870, is a rather rare disease. Generally the following stages are observed clinically: (1) Erythematous primary stage; (2) Hyperpigmentation (also called melanosis) on body areas exposed to sunlight; (3) Scar formation with skin atrophy combined with telangiectasis, hornification, wart formation, and ulceration; (4) tumor formation.

The authors report a case with lesions on the face and both hands in the pre-terminal stage and metastatic involvement of the lungs, demonstrated radiologically, and of the pectoralis major and minor of the left breast.

Etiology, pathogenesis, the role of consanguinity and heredity, and the extremely unfavorable prognosis are discussed in detail. The authors also mention accompanying diseases and the fact that this is the first recorded case of xeroderma pigmentosum with pulmonary metastasis.

Three roentgenograms; 3 photographs; 1 photomicrograph. HERBERT C. POLLACK, M.D.  
Chicago, Ill.

**Localized, Unilateral Radiolucent Lung.** F. Longin. *Fortschr. a. d. Geb. d. Röntgenstrahlen* 93: 673-687, December 1960. (In German) (Med. Poliklinik der Universität Würzburg, Germany)

Unilateral radiolucent lung can be due to various causes. Therefore, an etiologic classification is proposed. It differentiates underlying pulmonary artery hypoplasia with and without associated heart lesions and secondary hypoplasia due to idiopathic as well as non-obstructive juvenile emphysema. Single representative cases of each condition are reported and illustrated.

Radiolucent lung must also be differentiated from circumscribed radiolucency due to segmental or lobar emphysema. Different pathogenetic and morphologic factors, such as congenital or acquired bronchostenosis, play a role in this latter condition.

No pathognomonic signs could be found to trace emphysema to possible vascular factors. Therefore, the author advises against recently introduced terms like progressive pulmonary dystrophy and degenerative lung disease, as they imply vascular pathogenesis. The term "vanishing lung" connotes progressive bullous emphysema according to its originator.

Seventeen roentgenograms.

ERNEST KRAFT, M.D.  
Northport, N. Y.

**Progressive Respiratory Insufficiency, Bullous Emphysema, and Diffuse Pulmonary Leiomyomatosis.** J. Delarue, J. Paillas, P. Paley, Ph. Daumet, and M. Daussy. *J. franç. de méd. et chir. thorac.* 14: 761-771, 1960. (In French) (Paris, France)

A mother of eight children was seen at the age of fifty-one and, although sputum studies were negative, the radiographic impression of tuberculosis was followed by treatment for this condition. During four years the patient had intermittent therapy and noticed increased dyspnea. At the age of fifty-seven she was admitted for hospital studies. At this time she had considerable dyspnea and some degree of cyanosis of the lips and

fingers. She coughed rather frequently, with the production of mucus, and had lost approximately 50 pounds weight in three years.

Radiographic study demonstrated rather extreme thickening of interstitial tissues throughout both lungs, with a tendency to form nodules, and large emphysematous bullae interspersed throughout the lungs. Pulmonary biopsy showed proliferation of the smooth muscle in the interstitial tissue. About three weeks later the patient died and postmortem studies confirmed the biopsy findings. Smooth-muscle-tissue proliferation was seen throughout the interstitial tissue in both lungs.

Two roentgenograms; 2 photographs; 8 photomicrographs. CHARLES M. NICE, JR., M.D., Ph.D.  
Tulane University

**Pulmonary Alveolar Microlithiasis Demonstrated by Biopsy.** R. Israel-Asselain, J. Chebat, R. Abelanet, and J. Lechien. *J. franç. de méd. et chir. thorac.* 14: 635-660, 1960. (In French) (Laboratoire d'anatomie pathologique de la Faculté de médecine de Paris, France)

A case of pulmonary alveolar microlithiasis confirmed by biopsy is reported. It was first discovered on a routine chest film of a 16-year-old white girl, although it had apparently been present since the age of six.

The case report is followed by a complete review of the available literature on the subject. The condition is rare, may start at any age, and may have a familial tendency. About half the patients are asymptomatic when first seen, the microliths being discovered on routine roentgen examination. Others may have various types of pulmonary disorder with different degrees of pulmonary insufficiency. The exact etiology and pathogenesis are unknown.

Radiographic signs include fine disseminated calcifications throughout both lung fields, distinct pleural outlines, especially in the fissures, and thickened interstitial fibrotic lines, extending outward from the hilar structures. Usually the hilar lymph nodes are not enlarged.

Treatment has not been satisfactory. Steroids have been tried without definite results. The prognosis varies: in some patients pulmonary insufficiency develops at a rather early age; in others the disease follows a fairly slow evolution. Age at death has varied from twenty-eight to seventy-two years.

Six roentgenograms; 10 photomicrographs (4 in color); 2 tables.

CHARLES M. NICE, JR., M.D., Ph.D.  
Tulane University

**Experiences with Ultrahard X-Rays in the Diagnosis of Silicosis.** O. Zorn. *Fortschr. a. d. Geb. d. Röntgenstrahlen* 93: 332-342, September 1960. (In German) (Bergbau-Berufsgenossenschaft Bochum, Germany)

Cases are still being reported in which examination of the surgical or postmortem specimen of the lungs shows definite silicosis while the roentgenograms did not demonstrate enough change to permit an unequivocal diagnosis. An improvement over the conventional technic was obtained with a magnification of a section of the lung by an increase in the object-film distance and the use of a tube current of 100 to 120 kv and a grid with a ratio of 7:1. With this method, however, the exposure time is still rather long (0.06 seconds).

An attempt was made further to improve the technic



by lowering the exposure time and increasing the kilovoltage. Two methods have been tested with 150- and 200-kv rays. The author has studied 800 cases of silicosis, and from his experience believes that the best differentiation of the changes can be made with factors of 150 kv, 3 to 4 milliamperes seconds, an exposure time of 0.03 to 0.04 seconds, and a grid with a ratio of 15:1. With these, he has been able to demonstrate silicotic foci measuring only 0.5 to 1.0 mm. in diameter, with their perifocal emphysema. The changes of the lung tissues with their streaks of shrinkage and inflation, the perinodular emphysema, and the evidence of decay in the fibrous tissue can be made obvious in their whole extension without the need of tomography.

In cases of so-called pure quartz lungs and in patients with silicosis combined with tuberculosis, the use of a 2-mm. aluminum filter is also recommended, the better to demonstrate the small hard calcified foci.

Twelve roentgenograms.

WILLIAM A. MARSHALL, M.D.  
Chicago, Ill.

**Large-Scale Mass X-Ray Campaigns. A Survey.** Myer Goldman. *Brit. J. Radiol.* **33**: 776-779, December 1960. (Walton Hospital, Liverpool, England)

The general organization of a large-scale mass x-ray campaign is described, as typified by those held in Glasgow, Edinburgh, and Liverpool in 1957, 1958, and 1959, respectively. The main results are summarized and compared, and the disposal of new cases is outlined.

Mention is also made of the follow-up of defaulters, and details are given of the rescrutiny of a sample of miniature films.

Significant abnormalities found were:

	Glas- gow	Edin- burgh	Liver- pool
Total (including tuber- culosis, carcinoma, cardiovascular dis- ease, bronchitis, bron- chiectasis)	17,806	6,790	9,158
Percentage of those radiographed	2.5%	2.5%	2.0%
Active pulmonary tuberculosis (new cases)	2,565	452	1,045
Malignant neoplasm (new cases)	347	101	161

THEODORE E. KEATS, M.D.  
University of Missouri

**Thoracic Duct in Cinerentgenography; Experimental Study.** P. Málek, A. Belán, and J. Kolc. *Fortschr. a. d. Geb. d. Röntgenstrahlen* **93**: 723-730, December 1960. (In German) (Institut für klinische und experimentelle Chirurgie, Prague, Czechoslovakia)

In dogs the thoracic duct was filled with Lipiodol by injection of the lymphatic vessels of a hindleg. The opaque oil passed through the popliteal and para-aortic nodes before it could reach the thoracic duct. Answers to four questions were sought: 1. Was it possible to obtain continuous filling of the thoracic duct? 2. What was the emptying mechanism into the superior vena cava? 3. What effect did the movement of the diaphragm have on the flow of contrast material? 4. What influence did arterial pulsation have on the thoracic duct?

Cinerentgenography with image intensification led to the following observations: 1. For continuous filling of the duct a large dose of Lipiodol was necessary. The duct varied in width throughout its length, having wide and narrow portions. 2. The emptying into the vena cava was in form of drops rather than spurts. 3. The oil was propelled only during inspiration. 4. Arterial pulsation was transmitted to the duct, chiefly at the aortic arch, but the duct was also capable of moving independently, especially during movement of the diaphragm.

Respiration is fundamental for the transport of the oil, but rhythmic decrease of venous pressure also causes emptying by means of suction. With the aid of cinerentgenography contraction of the duct wall can be easily followed.

In man, Lipiodol is inadvisable because it has to pass through many more nodes before it reaches the thoracic duct. There is marked retention in these sites, and the danger of oil embolism always exists. Injection of the spermatic ducts would therefore be more advantageous.

Twenty roentgenograms. ERNEST KRAFT, M.D.  
Northport, N. Y.

## THE HEART AND BLOOD VESSELS

**Cardiomegaly of Unknown Cause Occurring in a Family. Report of Three Siblings and Review of the Literature.** Raymond J. Walther, Irving M. Madoff, and Kurt Zinner. *New England J. Med.* **263**: 1104-1110, Dec. 1, 1960. (Boston City Hospital, Boston, Mass.)

There are several varieties of familial cardiomegaly of unknown cause whose interrelations and etiologies are not clear. Endocardial fibroelastosis, myocarditis, muscular subaortic stenosis, and "asymmetrical hypertrophy of the heart" have been reported in families. In addition to the above entities, there is the so-called familial cardiomegaly of the type described by Evans (*Brit. Heart J.* **11**: 68, 1949), 60 examples of which have now been recorded.

Among the 60 patients with familial cardiomegaly, dyspnea on exertion has been the most common symptom. Other complaints were faintness, syncope, palpitation, and, rarely, precordial distress. The appearance of the cardiac silhouette on x-ray study has been the most characteristic feature of familial cardiomegaly. Almost all hearts were enlarged in transverse diameter and were described as globular, with prominence of the left ventricle. The pulmonary vasculature was normal in most cases. In 18 of 32 cases in which electrocardiographic findings are reported, there was evidence of intraventricular block, usually involving the left bundle. Hypertrophy of the left ventricle was the next most common finding, seen in 16 patients. Microscopically, patchy fibrosis of the myocardium was present in almost all the limited number of cases which came to autopsy. In Evans' cases, inflammatory cells or evidence of old inflammation was lacking. It is suggested that for the sake of better characterizing the disease which he called familial cardiomegaly, absence of inflammation should be considered a criterion.

The authors report 3 cases of familial cardiomegaly in siblings. The important clinical features were: little or no symptomatology; normal blood pressures; lower-left-sternal-border and apical systolic murmurs of borderline significance on physical examination; concentric enlargement of the left ventricle, with normal



vasculature on x-ray examination; abnormal electrocardiograms of variable pattern; a normal hemodynamic picture in 1 catheterized patient; sudden death in 2 at the age of eight; and massive hypertrophy of the left ventricle, with increased interstitial connective tissue and absence of inflammatory cells in the 2 autopsied cases.

Patients suspected of having this condition should be evaluated carefully, particularly for the presence or absence of outflow-tract obstruction of the left ventricle, since some of the new surgical procedures may prove helpful.

Four roentgenograms and electrocardiograms; 2 photographs; 2 photomicrographs; 1 genealogical tree.

MORTIMER R. CAMIEL, M.D.  
Brooklyn, N. Y.

#### **Tetralogy of Fallot with Anomalous Tricuspid Valve Simulating Pulmonary Stenosis with Intact Septum.**

Henry N. Neufeld, Dwight C. McGoon, James W. DuShane, and Jesse E. Edwards. *Circulation* 22: 1083-1090, December 1960. (The Mayo Clinic, Rochester, Minn.)

A new anatomicopathologic entity consisting of the tetralogy of Fallot with an additional accessory flap of tricuspid valvular tissue is described, and the findings in 3 cases are summarized. The clinical picture in these cases suggested severe pulmonic stenosis with an intact ventricular septum associated with a right-to-left shunt. Cardiac catheterization, however, showed that the shunt was at the ventricular level. It revealed also that the right ventricular systolic pressure was significantly greater than the systolic pressure in systemic arteries. Therefore, it was assumed clinically that these cases were examples of severe pulmonary stenosis with a small ventricular septal defect. In the first case the diagnosis was established at autopsy, and in the second and third, at surgery.

The clinical history in these patients did not aid in the differential diagnosis. The physical findings were most suggestive of severe pulmonic stenosis with an intact septum. All 3 patients were cyanotic. A forceful impulse of the right ventricle is unusual in tetralogy of Fallot, but it was observed in 2 of the authors' 3 cases. All 3 patients had clubbing of the digits and distended cervical veins; cervical vein distention as a clinical sign of increased right atrial pressure is unusual in tetralogy of Fallot but is often seen in severe pulmonary stenosis with an intact ventricular septum. Roentgen examination showed slight to great enlargement of the heart; this finding is also unusual for the tetralogy of Fallot. The pulmonary vasculature was diminished in each case. Evidence of poststenotic dilatation of the pulmonary artery was absent. The outstanding hemodynamic finding was the higher right ventricular systolic pressure as compared to the systemic systolic pressure. In the 2 patients in whom dye-dilution studies were performed, a right-to-left shunt at the ventricular level was demonstrated. Since it is usually assumed that the right ventricular pressure in the tetralogy of Fallot is about equal to the systemic pressure, a significant differential immediately places doubt on the diagnosis of a classic tetralogy.

The authors believe that in these cases the additional flap on the tricuspid valve was responsible for the increase of right ventricular pressure, as this flap partially closed the ventricular septal defect during systole. This partial closure of a large defect during ventricular

systole changes the dynamics from those of the usual tetralogy of Fallot into those representative of cases with severe pulmonary stenosis and a small ventricular septal defect.

Seven figures, including 3 roentgenograms; 2 tables.  
ZAC F. ENDRESS, M.D.  
Bloomfield Hills, Mich.

#### **Tricuspid Atresia in Infancy. Its Angiocardiographic Diagnosis.** A. Castellanos, Otto García, and Eloina González. *Radiología* 11: 21-27, December 1960 (In Spanish) (Habana, Cuba)

Of 881 patients examined by angiocardiography, 32 had tricuspid atresia. Of these, 75 per cent showed typical radiographic findings. The authors feel that the frontal projection is most valuable in that appearance in this plane is often pathognomonic, and the status of the pulmonary circulation is also best appraised. Selective angiocardiography appeared to offer no practical advantages over simple intravenous injection. The most difficult cases to diagnose were those with dextrocardia.

Attention is called to 6 cases in which aneurysmal dilatation of the inferior vena cava was encountered. While this may also occur in other conditions, its high frequency with tricuspid atresia is worthy of note. Also mentioned is the commonly observed inverse relationship between cyanosis and pulmonary circulation, and it is suggested that in cases of tricuspid atresia with pulmonary plethora, the pulmonary artery probably arises from the left ventricle.

One table.  
DON E. MATTHIESEN, M.D.  
Phoenix, Ariz.

#### **Left Ventriculo-Right Atrial Communication. Diagnosis by Clinical, Hemodynamic and Angiographic Methods.** Eugene Braunwald and Andrew G. Morrow. *Am. J. Med.* 28: 913-920, June 1960. (National Heart Institute, Bethesda, Md.)

Until recently those forms of ventricular septal defect which permit the passage of blood directly from the left ventricle to the right atrium have been considered rare and have been recognized only at necropsy. With the wider application of surgical procedures for the correction of atrial and ventricular septal defects, an increasing number of such lesions have been encountered, thus far only unexpectedly, at the operating table. In 4 patients with left ventriculo-right atrial communications recently studied, the correct diagnosis was suggested by the combination of (1) the clinical findings usually associated with ventricular septal defect, (2) the demonstration at catheterization of a left-to-right shunt terminating in the right atrium; and (3) an intact interatrial septum shown by catheterization via the saphenous route. The definitive diagnosis was established by selective angiocardiography with left ventricular injection in 3 patients and at operation in the fourth.

It would appear that selective angiography should be utilized whenever left ventriculo-right atrial communication is suspected. In the presence of an intact interatrial septum, injections of contrast medium into the left ventricle may be made either percutaneously or by retrograde arterial catheterization. Left ventricular angiography is of value in differentiating left ventriculo-right atrial communication from isolated ventricular septal defect and the varieties of atrioventricular canal. When there is a ventricular septal defect with tricuspid

incompetence, left ventricular angiography will first reveal opacification of the right ventricle, followed by right atrial filling. In contrast, in patients with a left ventriculo-right atrial communication, right atrial opacification is immediate.

At present, the indications for surgical treatment of left ventriculo-right atrial communications would seem to be similar to those in the more usual types of ventricular defect. Operation was recommended in 2 of the authors' patients because of pulmonary hypertension and a relatively large left-to-right shunt. Surgery was deferred in the other patients in whom the pulmonary artery pressure was normal and the pulmonary blood flow only slightly greater than the systemic flow.

Nine figures, including 6 roentgenograms.

**Cine-angiocardigraphic Studies of the Outflow Tract in Isolated Pulmonary Valvular Stenosis.** Hamish Watson, C. Pickard, K. G. Lowe, and Ian G. W. Hill. *Brit. Heart J.* 22: 706-712, November 1960. (University of St. Andrews, Dundee, Scotland)

Much of the confusion and misunderstanding concerning the nature of the obstruction to the outflow of blood from the right ventricle in patients with pulmonary stenosis is being resolved and the complex nature of the problem more fully recognized. An intriguing and controversial aspect of the subject lies in the concept of acquired infundibular obstruction in patients with congenital pulmonary valvular stenosis due to massive hypertrophy of the right ventricle. Because of the uncertainty regarding the importance of infundibular obstruction due to muscular hypertrophy in pulmonary valvular stenosis, surgeons are divided in opinion as to the need for infundibular resection along with pulmonary valvotomy. In severe stenosis with right ventricular hypertrophy there is usually a systolic pressure gradient at the valve site only and, though the infundibular lumen may be narrowed, the right pressure is uniformly distributed throughout the ventricular cavity. In some cases, however, following successful valvotomy an infundibular systolic pressure may become evident, and in these the narrowing of the infundibular lumen presumably remains the sole obstruction to rapid outflow of blood.

The authors believe that selective cineangiocardigraphy of the right ventricular outflow tract and cardiac catheterization with combined recording of the pressure pulse and intracardiac electrocardiography provide the most complete analysis of the nature of the obstruction in pulmonary stenosis. In general, the degree of narrowing of the infundibular lumen is roughly proportional to the severity of the pulmonary valvular stenosis, as judged by the right ventricular systolic pressure, and the duration of the dilated phase in diastole is inversely proportional to the severity of the stenosis. Narrowing of the infundibulum is no momentary event, and in severe valvular stenosis it persists for the greater part of the cardiac cycle. The demonstration of a phase of dilatation, however brief, is good evidence against obstruction from a fibrous or unyielding barrier.

Three cineradiographic series; 1 tracing.

RICHARD A. ELMER, M.D.  
Atlanta, Ga.

**Correlation of the Roentgen Appearance of the Thoracic Aorta in Life with the Degree of Stenosing Arteriosclerosis of the Coronary Arteries at Necropsy.** Irving M. Liebow, Robert R. Oseasohn, George F.

Badger, and Benjamin Kaufman. *Circulation* 22: 1133-1136, December 1960. (Western Reserve University, School of Medicine, Cleveland 6, Ohio)

The "Nomenclature and Criteria for Diagnosis of Diseases of the Heart and Blood Vessels" of the New York Heart Association states in part that the diagnosis of coronary artery heart disease rests upon the finding of abnormal physical signs indicating arteriosclerosis of the aorta. This implies that there is a positive correlation between the presence of arteriosclerosis of the aorta and stenosing arteriosclerosis of the coronary arteries. To test the validity of this assumption a comparison was made between the appearance of the thoracic aorta as seen on a roentgenogram taken shortly before death with the degree of stenosing coronary arteriosclerosis noted at necropsy.

Consecutive autopsy records of 463 patients were reviewed. Of these, 137 fulfilled the criteria necessary for the analysis: satisfactory chest roentgenogram within ninety days of death; mention of the degree of coronary arteriosclerosis; absence of evidence of syphilis of the aorta; patient over the age of fifteen years. All roentgenograms were re-read, with attention focused on the aorta.

The results indicate that roentgenographic evidence of arteriosclerosis of the thoracic aorta, whether calcification (intimal atherosclerosis) or enlargement (medial arteriosclerosis), does not constitute an accurate basis for the diagnosis of coronary arteriosclerosis. Indeed, more accurate information concerning the state of the coronary arteries is obtained by simply noting the patient's age. It is therefore concluded that arteriosclerosis of the aorta observed roentgenographically should not be a criterion for the etiologic diagnosis of coronary artery heart disease.

Two tables.

ZAC F. ENDRESS, M.D.  
Bloomfield Hills, Mich.

**Unusual Oesophagram in an Aneurysm of Arch of Thoracic Aorta.** M. G. Varadarajan. *Mediscopes*, June 1960. (Government General Hospital, Madras, India)

The author studied 63 aneurysms of the aorta, which included 21 of the ascending arch; 17 of the transverse arch; 2 of the descending thoracic aorta; 2 of the innominate artery; 2 of the sinus of Valsalva; 2 of the abdominal aorta; 4 multiple aneurysms, 1 of the popliteal artery.

The symptoms and signs of aortic aneurysms are related to the anatomical point of origin of the sac and the direction in which it points. With dilatation of the aorta, the esophagus must necessarily be affected. As the aorta elongates and dilates, it migrates cephalad, the aortic impression on the esophagus becomes higher and wider, and ultimately the esophagus is pushed to the right and posteriorly. These pathological changes are best demonstrated in postero-anterior and left anterior oblique views. The displacement of the esophagus is not always purely lateral; it may bend simultaneously forward or backward. Some aneurysms force their way between the trachea and spine to press the trachea forward to the right and the esophagus to the right. Others develop between the esophagus and spine and displace the esophagus to the right and forward. Occasionally an aneurysm of the arch protrudes between the trachea and esophagus backward to the left. In all these cases the compression of the esophagus may result in dysphagia.

A case is reported in which the esophagus and trachea

were displaced to the right and anteriorly instead of posteriorly.

ZOLTAN SZALONTAY, M.D.  
Mercy Hospital, Pittsburgh, Penna.

**Atypical Symptomatology of Aortic Arch Atresia Due to Additional Vascular Anomalies.** F. Loogen and H. Vieten. *Fortschr. a. d. Geb. d. Röntgenstrahlen* 93: 730-735, December 1960. (In German) (Medizinische Akademie Düsseldorf, Germany)

In coarctation of the aorta a pressure gradient exists, so that the blood pressure in the arms is higher than in the legs. An exception to this rule, however, was observed in a 4-year-old boy admitted to the hospital with a diagnosis of congenital heart disease. The heart was enlarged to the left and a systolic murmur was heard over the entire precordium upward to the carotids, most pronounced over the second intercostal space. The blood pressure was 105/80 mm. Hg in the upper extremities and 115/90 mm. in the lower extremities. Pulsation in the peripheral arteries was weak.

Clinically, congenital aortic stenosis was suspected, with a vague suggestion of ventricular septal defect. Selective angiocardiology revealed coarctation in the region of the aortic isthmus. Both carotids filled directly from the aorta proximal to the coarctation. The subclavians filled only in a later phase, distal to the coarctation as branches of the descending aorta.

These unusual vascular abnormalities explained the absence of hypertension in the upper extremities as well as an equal pressure in arms and legs. Increased blood pressure, however, was present in the carotid arteries as they branched off from the prestenotic area of the aortic arch.

In retrospect, a visible vigorous pulsation of the carotids and weak pulsation in upper and lower extremities could have led to a suspicion of the rare vascular anomalies. Visible pulsation of the carotids was contrary to what one would expect in an organic aortic stenosis. Actually, a mild subvalvular aortic stenosis was found on a levogram subsequently obtained.

Five roentgenograms; 2 curves.

ERNEST KRAFT, M.D.  
Northport, N. Y.

**Selective Angiography of Supra-Aortic Branches as Necessary Preoperative Procedure for Aortic-Arch Syndrome.** W. Porstmann. *Fortschr. a. d. Geb. d. Röntgenstrahlen* 93: 735-745, December 1960. (In German) (Institut für Röntgendiagnostik der Charité, Berlin, Germany)

Retrograde aortography is known to yield valuable data regarding the aortic arch and its branches. When, however, branches are narrowed or obliterated, selective angiography is indicated with the tip of the Seldinger catheter guided into a patent artery.

The Takayashu syndrome, also known as obliteration syndrome of supra-aortic branches and pulseless disease, is a condition in which vital preoperative information can be obtained by selective angiography. Obliterated arteries can be successfully replaced by plastic tubes, but the surgeon must be supplied with answers to the following questions: (1) Which branches of the aortic arch are involved? (2) To what extent are the branches obliterated? (3) Are patent branches still present distal to the stenosed artery to make vascular reconstruction possible? (4) Are intracranial communications sufficiently preserved so that cerebral ischemia can be overcome by elimination of extracranial stenoses?

Two cases of pulseless disease are reported to illustrate the author's technic and the aid he was able to contribute to the surgeon. In the first case the catheter could be introduced into the left vertebral artery upward to the level of the axis. The right vertebral artery received blood in retrograde fashion from the left via the basilar artery, but not proximally, as the right subclavian was obliterated. The right carotid artery and branches were completely obliterated, the left only to its bifurcation. The left carotids received blood through communications with the left vertebral artery, the only remaining link to the cerebrum. It supplied the cerebellum, both occipital lobes, and the right hemisphere. The left hemisphere received blood also from the left vertebral artery through communications with the left internal carotid artery stump. The latter could be successfully linked with the aortic arch by a plastic tube. The right vertebral artery could be properly connected with the brachiocephalic trunk proximally through thromboendarterectomy.

In the second patient pulsation could not be felt in either arm or in the neck. There was complete absence of regular branches of the aortic arch, but a convolution of small arteries instead. The latter appeared more like collaterals than brachiocephalic branches. Therefore, no selective angiography could be done at this time. In a later phase there were filling of both common carotids, starting at a point close to the bifurcation, and collateral circulation leading to both arms. In the reconstruction, plastic tubing was used to connect the aortic arch with the axillary and common carotid artery on the right side.

Both patients were middle-aged women with histologically verified arteritis causing the aortic arch syndrome.

A third case is briefly reported in which pulseless disease affecting both arms developed on a degenerative arteriosclerotic basis. The patient was a 65-year-old woman. Selective angiography of both subclavians through percutaneous catheterization of a femoral artery revealed complete obliteration of the axillary arteries. There was, however, well developed collateral circulation through intercostals on one side and transverse scapular arteries on the other. Carotid and vertebral arteries were nearly normal. Therefore, no surgical procedure was indicated.

Eleven roentgenograms; 1 drawing.

ERNEST KRAFT, M.D.  
Northport, N. Y.

**Emergency Use of Antegrade Aortography in Diagnosis of Acute Aortic Rupture.** Hu A. Blake, Thomas W. Inmon, and Frank C. Spencer. *Ann. Surg.* 152: 954-956, December 1960. (Walter Reed General Hospital, Washington 12, D. C.)

The use of antegrade aortography in a patient with suspected acute aortic rupture is reported, and the technic of the procedure is described briefly. The patient was a 23-year-old man who was seen four days after injury in an automobile accident. The chest roentgenogram revealed widening of the mediastinum, which aroused suspicion of rupture of the aorta. Hypaque 90 per cent, 1.2 c.c. per kilogram of body weight, was injected directly into the right atrium through a NIH catheter passed through an arm vein. An atrium-to-tongue circulation time was first obtained by injection of a test sample of Decholin, Hypaque, and dextrose in water. Film exposures were made at 0.6-second inter-

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vals beginning four seconds before and ending four seconds after the circulation time. Aortic rupture was clearly shown, and thoracotomy confirmed the diagnosis.

The aortic visualization achieved in this case was quite satisfactory, and only slightly less opacification was obtained than with the more formidable technic of retrograde aortography. Passage of a catheter into the atrium through a large vein is rapidly and easily performed as contrasted to the time-consuming catheter passage and positioning through a small and often spastic brachial or radial artery.

Two roentgenograms; 1 drawing.

GOREN L. BARTEK, M.D.  
Grand Rapids, Mich.

**Anatomical Studies of the Lumbar Arteries: With Reference to the Safety of Translumbar Aortography.** Harold Laufman, Ralph E. Berggren, Thomas Finley, and Barry J. Anson. *Ann. Surg.* 152: 621-632, October 1960. (Northwestern University Medical School, Chicago, Ill.)

It is generally agreed that the incidence of severe complications following properly performed aortography is sufficiently low when compared with the diagnostic value of the procedure to warrant continued efforts to improve its safety. The goals of anatomical studies carried out by the authors were to determine: (1) the pattern of the origins and extravertebral courses of the lumbar arteries; (2) the relationship of various positions of the tip of an aortographic needle to the ostia and lumina of the lumbar arteries; (3) the angle and position of a translumbar aortic needle least likely to result in the injection of relatively undiluted contrast medium into the lumbar arteries.

Dissections of the lumbar arteries were made in 50 cadavers, and the origins and courses of each lumbar vessel from T12 through L5 were mapped. In the upper lumbar and lower thoracic areas, the largest number of ostia were found at the levels of the intervertebral spaces, and the lowest incidence at the middle thirds of T12 and L1 and the middle and upper thirds of L2. However, the renal arteries generally arise at or near the level of the middle third of the first lumbar and the superior mesenteric artery usually arises at the middle third of T12. This sharp quantitative stratification of vessels within a distance of 1 or 2 cm. emphasizes the anatomical risks in a relatively blind procedure.

The problem was investigated further by dissections following the blind insertion of needles, with use of the landmarks usually employed in clinical aortography. Some of the needles were manipulated to simulate attempts to enter the aorta, as is sometimes necessary in the performance of the procedure. Examination after these deliberate manipulations revealed that the likelihood of entering the lumen of a lumbar artery is not great, provided the usual technic of insertion is followed.

Except for a resulting extravasation or propagating thrombosis, the consequences of injury to a lumbar vessel are probably not of great moment unless the contrast agent is injected into its lumen in high concentration. Paraplegia has been reported following injection of as little as 10 c.c. of Urokon.

Because the comparatively bare area at the middle third of the twelfth thoracic vertebra is the usual site of origin for the superior mesenteric artery, and that of the first lumbar vertebra coincides with the usual origin

of the renal arteries, the safest area for puncture of the aorta below the renal arteries appears to be at the middle third of the second lumbar vertebra. The safest area above the renal arteries is probably at the lower third of T12. No more contrast medium should be injected than necessary, and excessive pressure for injection should be avoided. The two-needle technic should be discarded. Multiple punctures of the aorta with the same needle during the same procedure should be avoided, as well as multiple injections through the same needle in rapid succession. Less force and less contrast material should be used when an occlusion is known to exist in the terminal aorta.

Eleven figures.

GEORGE A. SHIPMAN, M.D.  
Staten Island, N. Y.

**Changes of Renal Oxygen Availability During Urokon and Hypaque Aortography.** Duncan A. Killen and Guy Owens. *Ann. Surg.* 152: 957-962, December 1960. (Vanderbilt University School of Medicine, Nashville, Tenn.)

Renal damage is the most frequently encountered serious complication of abdominal aortography. The exact mechanism of renal injury is not known. The authors undertook an evaluation of the role of alterations of the renal tissue oxygenation during aortography. Urokon and Hypaque, which represent the extremes of media as regards nephrotoxicity, were employed in the investigation.

Twelve healthy adult mongrel dogs were used as test animals. Laparotomy was performed, and a portion of the capsule of one kidney was teased off the renal parenchyma. A Clark oxygen polarograph electrode was brought into contact with the denuded kidney surface. After the polarograph tracing had stabilized, the renal artery was occluded, and the renal oxygen dissipation monitored. The occlusion was released once the renal oxygen availability had stabilized at a minimum (complete anoxia) value. Following a recovery period of a few minutes duration, either normal saline, Urokon 70 per cent, or Hypaque 90 per cent was injected into the abdominal aorta over a five-second period. Polarographic tracings were taken during the injection and for five to ten minutes thereafter.

Abdominal aortic injection of physiologic saline solution in no instance caused detectable alterations in the polarographic tracing. Injection of Urokon was consistently followed by an abrupt fall of renal oxygen availability which reached a minimum of 0 to 58 per cent of resting oxygen within one-half to three minutes. The oxygen availability had risen to 28 to 92 per cent of the resting level by the end of the five to ten minute observation period. The changes were neither so consistent nor so marked following Hypaque injection. In 3 animals there was a brief period of moderate depression of renal oxygen availability (down to 44 per cent of resting levels in 1 animal). In 2 animals in the Hypaque group, the oxygen availability was depressed (58 and 88 per cent of resting levels) ten minutes postinjection. Three animals succumbed less than forty-eight hours after the injection of the contrast medium (Urokon in 2, Hypaque in 1). Azotemia developed in all animals receiving Urokon, but in none of those given Hypaque.

The period of depression of renal oxygen availability following Urokon perfusion is so brief that the authors consider it very improbable that anoxia *per se* is the primary mechanism of the kidney damage produced



by aortographic contrast media more (specifically Urokon). This fact, in turn, is indirect evidence that the nephrotoxicity of Urokon is based upon a direct cellular effect.

One drawing; 2 graphs; 1 table.

GORDON L. BARTEK, M.D.  
Grand Rapids, Mich.

**The Direction of Blood Flow in Anomalous Left Coronary Artery Arising from the Pulmonary Artery.** David C. Sabiston, Jr., Catherine A. Neill, and Helen B. Taussig. *Circulation* 22: 591-597, October 1960. (The Johns Hopkins University School of Medicine, Baltimore 5, Md.)

Myocardial infarction in infancy secondary to the anomalous origin of the left coronary artery from the pulmonary artery is now being recognized with increasing frequency during life. One of the more interesting aspects of this congenital abnormality is the problem of the direction of the blood flow in the left coronary artery. If the flow is retrograde, it is apparent that one of the coronary arteries is not only failing to supply the myocardium but is actually draining fully oxygenated blood from the heart into the pulmonary artery. The present communication concerns a patient with anomalous origin of the left coronary artery from the pulmonary artery in whom the direction of blood flow was studied and demonstrated conclusively.

The patient was a 2 1/2-month-old infant, with dyspnea, a heart murmur, and difficulty in eating. Respirations were 44 per minute and of a grunting quality, but there was no marked respiratory distress. The heart was enlarged to the left anterior axillary line and the sounds were somewhat distant. Roentgenograms of the chest showed marked cardiomegaly with normal pulmonary vascular markings. Cineangiocardiology revealed a small right heart with a massively dilated left ventricle. A diagnosis of anomalous origin of the left coronary artery from the pulmonary artery was made, and this diagnosis was confirmed at surgery. Determinations of arterial pressure and oxygen saturation in the blood of the anomalous artery at the time of thoracotomy demonstrated that the blood in this vessel flowed in a retrograde manner. It is concluded that in the presence of an anomalous left coronary artery arising from the pulmonary artery oxygenated blood flows from the aorta into the normal right coronary artery and passes through collateral branches into the left coronary artery, with ultimate drainage into the pulmonary artery.

Ligation of the anomalous coronary artery with concomitant de-epicardialization appears to be a rational and effective method of therapy. For maximal effectiveness the operation should be performed prior to the onset of irreversible changes, and emphasis is placed upon the importance of early diagnosis and treatment. In the authors' case, the anomalous artery was ligated, and concentrated phenol was applied to the entire surface of the heart to promote revascularization of the left ventricle. The patient exhibited considerable clinical improvement following surgery. Six months after operation an electrocardiogram showed less evidence of left ventricular myocardial ischemia, and a chest roentgenogram revealed a slight decrease in the size of the heart.

One roentgenogram; 2 drawings; 1 electrocardiogram.

ZAC F. ENDRESS, M.D.  
Bloomfield Hills, Mich.

**The Small Pulmonary Arteries Studied by a New Injection Method.** W. R. L. James, G. M. Owen, and A. J. Thomas. *Brit. Heart J.* 22: 695-705, November 1960. (Cardiff Radiotherapy Centre, Cardiff, Wales)

The object of the work described here was to advance our knowledge of the changes in the pulmonary vascular bed that lead to right ventricular hypertrophy in certain cases of cardiac and respiratory disease. Injection studies in conditions such as mitral stenosis and congenital heart disease have suggested that the pulmonary arterial bed is reduced. Physiological investigations have established that acute anoxia and some pharmacological agents can produce a transient restriction in the pulmonary vascular bed. Lung injection studies in pulmonary angiography of mitral stenosis and in post-mortem specimens have shown the bare or pruned tree picture indicating that the smaller vessels of the pulmonary arterial bed have been narrowed or obliterated. The assessment of these pictures, however, has been visual, with no actual measure of the change; consequently in some cases of lesser degree it has been difficult to decide how much change has taken place. The authors have developed a method of injecting lung specimens in such a way as to obtain a measure of the volume of the arterial bed in their peripheral areas; this is described in detail.

By incorporating a radioactive substance (radioiodinated human serum albumin) in the radiopaque medium, it has been possible to obtain measurements of the small arterial bed (2-mm. to 30-micron vessels). The measurement is expressed in terms of volume of small arteries per unit volume of lung, and the mean and the range for normal lungs has been ascertained. Lungs with a reduced vascular bed have been grouped according to the causes, such as mitral valve disease, aortic valve disease, pulmonary hypertension, left ventricular failure, and emphysema. The method has shown much reduction of the small arterial bed of the lungs in cases of aortic valve disease and of systemic hypertension in cardiac infarction with left ventricular hypertrophy.

An analysis of 10 cases of emphysema is presented; the observations indicate that the reduction in the small arterial bed is much more than the microscopic appearance of the emphysema would suggest. Smaller vessels disappeared, while many of those remaining had thick walls and narrow lumens. The method measures the total reducing effect of these changes.

The findings in the differing groups of cardiac and respiratory disease are in accord with the view that elevation of capillary pressure or damage to the capillary bed acts as an immediate stimulus to restriction of the associated small arterial bed to protect the capillaries. Such reduction may be identified by measurement before it has produced changes that can be confidently recognized microscopically.

Eight figures, including 6 injection radiographs.

RICHARD A. ELMER, M.D.  
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**Splenic Artery Aneurysm. Diagnosis by Intravenous Abdominal Aortography.** Israel Steinberg and Jere W. Lord, Jr. *J.A.M.A.* 174: 74-77, Sept. 3, 1960. (525 E. 68th St., New York 21, N. Y.)

The clinical features of splenic artery aneurysm, that is pain in the left upper quadrant and splenomegaly, are so nonspecific that they provide little aid in diagnosis. A sign of greater significance, though rare, is a

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palpable, occasionally pulsatile, tumor in the left hypochondrium. The diagnosis depends mostly on roentgenography. The demonstration of rounded or oval egg-shell calcifications in the left upper quadrant of the abdomen should raise the suspicion of splenic artery aneurysm. Differentiation from renal and gastrointestinal calcifications can readily be made by contrast roentgenography. Pancreatic stones are more difficult to differentiate but, now that a method of opacifying the aorta via the intravenous route is available, this need not delay definitive diagnosis.

Two cases are reported. The first patient was a 54-year-old woman who complained of backache of several months duration. A roentgenogram of the lower part of the back disclosed calcifications in the left upper quadrant. Intravenous abdominal aortography showed a normal abdominal aorta and an aneurysm of the splenic artery. A 3.0-cm. pulsatile aneurysm, partially calcified in a shell-like fashion, was found at surgery.

The second case underscores the inherent danger of splenic artery aneurysm. A 57-year-old man was admitted to the hospital in shock, apparently due to an intraperitoneal hemorrhage. A gastrointestinal series four months previously had shown the stomach displaced anteriorly by a smooth mass posterior to it. Exploration established the diagnosis of splenic aneurysm, with a large amount of blood in the lesser peritoneal cavity. Slow refilling of the mass after aspiration of blood was suggestive of a small opening between the splenic artery and the aneurysm.

Excision of the aneurysm and splenectomy were curative in both cases.

Two roentgenograms; 3 photographs.

ALFREDO TENAGLIA, M.D.  
St. Vincent's Hospital, New York

**The Effects of Specific Gravity upon the Distribution of Intravascular Contrast Agents.** Charles T. Dotter, William Veatch, David Wishart, and Pamela Dotter. *Circulation* 22: 1144-1148, December 1960. (University of Oregon Medical School, Portland, Ore.)

Experimental and clinical studies indicate that gravity plays a significant role in the distribution of contrast media injected into the cardiovascular system. Recognized, this factor need not give rise to false interpretation of findings; exploited, it may serve to enhance the selectivity of contrast visualization under appropriate circumstances.

Experiments were performed to ascertain the extent to which the relatively greater specific gravity of contrast media could be employed to enhance selective visualization. Roentgenograms are reproduced to illustrate the effects of position during coronary arteriography in the dog and abdominal aortography in a patient. If selective filling of certain branches is desired or is to be avoided, the proper position of the patient relative to the effect of gravity must be selected. For example, the anterior branches of the abdominal aorta are best visualized in the prone position, and the posterior lumbar arteries in the supine.

[Killen and Foster (*Ann. Surg.* 152: 211, 1960. *Abst. in Radiology* 77: 150, 1961) called attention to the fact that spinal cord damage is much more common when aortography is performed in the supine position because the lumbar vessels receive more contrast material and carry it to the cord.—Z.F.E.]

Eleven roentgenograms. ZAC F. ENDRESS, M.D.  
Bloomfield Hills, Mich.

**Intravenous Angiography: Its Place in a Small, Well Equipped, General Hospital.** S. B. Feinberg and M. E. Goldberg. *Minnesota Med.* 43: 754-758, November 1960. (737 East 22d St., Minneapolis 4, Minn.)

With the rapid injection of large quantities of highly concentrated iodinated contrast media coupled with a rapid film-changer, intravenous angiography is a simple and safe means of diagnosis and evaluation of multiple vascular and nonvascular lesions in the course of the great vessels and their immediate branches. The need and feasibility of surgery can be determined by this means.

The technic has become routine in the authors' department. In order to deliver a sufficiently concentrated bolus of medium to the left heart and aorta, they use a large volume of either 90 per cent Hypaque or 85 per cent Renografin, in a volume of approximately 1.0 c.c. per kilogram up to a total of 100 c.c. The bolus is injected in its entirety within one or two seconds with an Elema-Schönander mechanical injector.

Fourteen roentgenograms.

**The Clinical Employment of Eight-Lead Radiography in Studies of the Cardiovascular Function.** N. A. Gabelova and G. A. Malov. *M. Radiol., Moscow* 5: 17-29, December 1960. (In Russian)

A new isotope method has been used in functional examination of the cardiovascular system in over 300 patients. Eight radiation counters are placed over the patients: 1 on the arm, 3 on the chest, 2 over the groins, 1 on the thigh, and 1 on the knee.  $\text{Na}^{24}$  is injected intravenously, and counts from the 8 leads are recorded simultaneously and continuously. The procedure has proved of value in the study of circulation times in the pulmonary and peripheral circulations. Circulatory delays in mitral stenosis are graphically portrayed, arteriovenous fistulas are demonstrated, and septal defects are diagnosed by the prompt appearance of radioactivity in the lower leads. The method is also useful in evaluation of improved function after heart surgery.

Eleven figures.

FRANK A. RIEBEL, M.D.  
Columbus, Ohio

## THE DIGESTIVE SYSTEM

**Diffuse Spasm and Diffuse Muscle Hypertrophy of Lower Oesophagus.** A. S. Johnstone. *Brit. J. Radiol.* 33: 723-735, December 1960. (General Infirmary, Leeds, England)

The author calls attention to some of the patterns of abnormal esophageal behavior and classifies them within the various categories of neuromuscular disorders, including cardiospasm, diffuse muscular hypertrophy of the lower esophagus, and the abnormalities described as "curling" and "corkscrew" esophagus.

The basis of the radiological diagnosis in these conditions lies chiefly in the departure from the accepted sequence of movement set up by swallowing. Contractions are defined as abnormal if they depart from the usual pattern of peristaltic movement; for example, the barium column may be held up by a single spasm or be broken up by multiple spasms. A thickened esophageal wall may be recognized radiologically by the demonstration of a line running parallel to the column of barium except where the lumen may suddenly narrow. Here the line will continue in its original direction, indicating further thickening at the site of

constriction. A wall shadow is only rarely seen in the radiograph of the normal esophagus but it is always visible in cardiospasm and is a valuable sign particularly in the early stages. It should not be assumed that a well defined wall shadow means muscle hypertrophy. A similar picture may be found in malignant infiltration and also in peptic esophagitis. There is nevertheless sufficient evidence to suggest that abnormal contractions and muscle hypertrophy are closely related.

The author compares the characteristics of cardiospasm with those of diffuse spasm as follows: *Cardiospasm*: (1) esophagus uniformly dilated above olivary contraction in terminal segment; (2) muscle hypertrophy slight to moderate; (3) degeneration of myenteric plexus; (4) marked response to parasympatheticomimetic agents; (5) not usually associated with other lesions; (6) symptoms absent or some dysphagia. *Diffuse spasm and muscular hypertrophy*: (1) esophagus contracted irregularly in lower half; (2) muscle hypertrophy marked to gross; (3) no significant degeneration of myenteric plexus; (4) no significant response to parasympatheticomimetic agents; (5) often associated with hiatus hernia, esophagitis, peptic ulcer, cancer, etc.; (6) symptoms rarely absent (severe retrosternal pain or acute obstruction).

The findings in a number of patients cannot be placed in either category, consisting only of a slight derangement in movement of the terminal segment, exemplified either by slight spasm or some irregularity in contraction.

The author concludes that there are two major neuromuscular disorders of the esophagus—cardiospasm and diffuse spasm of the lower esophagus. Many minor abnormalities such as pseudodiverticula, rosary, and corkscrew esophagus seem to fall into the category of diffuse spasm. From clinical and experimental evidence there are grounds for suggesting that diffuse spasm is due directly or indirectly to vagal overactivity, but in some instances inflammatory changes following peptic esophagitis and ulceration may be a causal factor.

Forty-two roentgenograms; 1 drawing; 1 table.

THEODORE E. KEATS, M.D.  
University of Missouri

**The Lower Esophageal Vestibular Complex. An Anatomic-Roentgen Study.** Costantino Zaino, Maxwell H. Poppel, Harold G. Jacobson, Harold Lepow, and Cahit H. Osturk. *Am. J. Roentgenol.* 84: 1045-1055, December 1960. (H. G. J., Montefiore Hospital, New York 67, N. Y.)

The authors undertook an anatomic-roentgen study (1) to determine the gross and microscopic differences in the vestibule of the esophagus as compared with the remainder of the esophagus for detection of the possible presence of a special intrinsic muscular system in the lower esophagus which regulates opening and closing, and to relate this area to Lerche's vestibule; (2) to correlate the roentgen and *in vitro* appearance of the vestibule; (3) to determine the existence and exact site of the attachment of the phrenoesophageal membrane and its relationship to Lerche's inferior esophageal sphincter; (4) to study the effects of tension of this membrane in the empty and full esophagus, roentgenologically; and (5) to evaluate the anatomic structure of the esophageal hiatus and its relationship to the vestibule, with particular reference to any "pinching"

action. This investigation has clearly established a rather constant anatomic muscular arrangement with a predictable physiologic response which can be determined roentgenologically. The authors have designated this special anatomic area and its complicated functions as "the lower esophageal vestibular complex."

A total of 70 consecutive autopsy specimens were chosen without regard to age, sex, or diagnosis. The lower esophagus, with its diaphragmatic attachment, and the upper part of the stomach were carefully removed as a unit in order to keep intact the region of the esophageal hiatus and the gastroesophageal junction. In 21 cases metal clips were placed at the gastroesophageal junction, at the upper attachment of the phrenoesophageal membrane, and at the lateral lips of the esophageal hiatus of the diaphragm. These specimens were then mounted on a special device so that the respiratory excursions of the diaphragm could be simulated mechanically. The specimens were then studied roentgenologically with both air and barium. Fifty-one specimens were also dissected, and the level of attachment of the phrenoesophageal membrane was determined.

Forty-five of the 70 specimens were sectioned for microscopic examination, and 19 of these were used for serial microscopic studies. Gross and microscopic studies indicate that the inferior esophageal sphincter does not exist as an actual anatomical landmark, but represents the superior portion of the vestibule, and that the level of the constrictor cardiae is the most inferior portion of the vestibule. In the closing mechanism of the lower esophagus, a valve action is located in the vestibule depending upon: (1) the extra muscle bundles; (2) increased thickness and different directional arrangement of the inner muscular layer; (3) the phrenoesophageal membrane.

This study demonstrates conclusively the presence of gross and microscopic anatomic differences in the vestibule as distinguished from the rest of the esophagus and confirms a specialized function. The contracted vestibule is seen roentgenologically as the narrowed segment at the distal end of the esophagus, several centimeters in length, connecting the lower esophagus to the stomach.

The authors conclude that: (1) An intrinsic mechanism exists in the lower esophageal segment, centered in the vestibule, which is limited above by Lerche's inferior esophageal sphincter located 1 to 2 cm. above the esophageal hiatus, and below by the constrictor cardiae or gastroesophageal junction about 1 cm. below the esophageal hiatus. The vestibular complex is normally contracted when at rest. It is surrounded and held in place by the phrenoesophageal membrane within the esophageal hiatus of the diaphragm. (2) The so-called "pinch-cock" action of the diaphragm is not real, but is due to the pull of the phrenoesophageal membrane and to the sphincteric action of the vestibule, which contracts in its entirety. (3) The essential mechanism is intrinsic in nature and controlled by reflex action initiated in the pharynx on swallowing and affecting the intraluminal pressure of the esophagus and vestibule. (4) There is an external factor influencing this mechanism; *i.e.*, the contraction or relaxation of the phrenoesophageal membrane secondary to the respiratory action of the diaphragm. This action modifies the flow of the bolus according to the respiratory phase, but it does not control the passage of the bolus except as it affects the intraluminal pressure.

Twelve roentgenograms; 4 photographs; 6 photographs; 2 drawings.

ROSCOE E. MILLER, M.D.  
Indiana University Medical Center

**Esophageal Defects in Dermatomyositis.** F. Edmund Donoghue, R. K. Winkelmann, and Herman J. Moersch. *Ann. Otol., Rhin. & Laryng.* **69**: 1139-1145, December 1960. (The Mayo Clinic, Rochester, Minn.)

To determine the incidence of esophageal involvement in dermatomyositis, the records of the Mayo Clinic were reviewed, and those of 38 patients were selected in whom a diagnosis of either dermatomyositis or polymyositis had been made and in whom investigation of the esophagus, either by roentgenography, esophagoscopy, and motility studies, or by each of these methods, had been made.

Thirty-two of the 38 patients complained of dysphagia. Two were unable to swallow even thin barium. With one exception, the patients localized the sensation of obstruction to the pharyngeal area. Nasal regurgitation was noted by 11.

Thirty-five of the 38 patients underwent radiologic examination of the upper gastrointestinal tract. The esophagus was found to be normal in 19. In 9 patients, peristaltic activity was diminished and in 3 it was not demonstrated. Laryngotracheal aspiration of barium occurred in 3 patients. One patient had an esophageal hiatal hernia.

Esophagoscopy was performed in 6 patients with no helpful findings. Esophageal motility studies (non-radiological) were done in 17 patients, and in only 9 was a normal tracing obtained. Various types of motility derangement were detected in the remaining 8 patients and in none was the motor abnormality confined to the pharyngeal area alone.

The presence of a generalized esophageal muscular defect substantiated by both roentgenographic and motility studies in 45 per cent of the patients is noteworthy. The incidence of hiatal hernia or evidence of ulcerative esophagitis complicating dermatomyositis was sufficiently infrequent to suggest the preservation of a protective barrier mechanism in the lower portion of the esophagus.

The roentgenologically demonstrable esophageal defects and the esophageal motility pattern in dermatomyositis and scleroderma are sufficiently similar to be indistinguishable. Clinically, however, one should have no trouble in differentiating the two conditions. Pharyngeal dysphagia and nasal regurgitation are frequent in dermatomyositis but are uncommon in scleroderma. Remission of the disease with adequate steroid therapy may be expected in dermatomyositis but not in scleroderma. Esophagitis, hernia, and ulceration are seen in scleroderma but are infrequent in dermatomyositis.

Four tables.

JAMES W. BARBER, M.D.  
Cheyenne, Wyo.

**Isolated Tracheoesophageal Fistula Demonstrated by Cinefluorography.** D. W. MacEwan, J. S. Dunbar, and D. R. Murphy. *J. Canad. A. Radiologists* **11**: 84-88, December 1960. (Montreal Children's Hospital, Montreal, Que., Canada)

Isolated high tracheoesophageal fistula in 2 infants—a 6-week-old girl and a 4-month-old boy—was demonstrated by cinefluorography. In both cases identification of the fistula was followed by successful

surgical treatment. Cinefluorography with injection into the esophagus of opaque material appears to be accurate and particularly useful in high fistulas where diagnosis by other methods has proved difficult.

Congenital tracheoesophageal fistula may be found at almost any age, but it is most frequent and its diagnosis and treatment are most important in early life. The authors' method of administration and choice of opaque medium has been described elsewhere (*Am. J. Roentgenol.* **82**: 902, 1959. *Abst. in Radiology* **75**: 490, 1960). An infant or young child who is suspected of having a disorder of the swallowing mechanism or tracheoesophageal fistula should first be investigated radiologically by catheterization of the esophagus and direct injection, preferably of Dionosil, into the lower, then the mid, then the upper esophagus. Many young infants have a disorder of swallowing which is primarily one of inco-ordination and will frequently resolve within the first few weeks or months of life. Separation from this group of congenital tracheoesophageal fistula presents a challenge in diagnosis and an opportunity in surgical therapy.

Two 10-serial frames of a cineradiographic study.

**Is Congenitally Short Esophagus Truly a Rare Clinical Entity?** William A. Lell. *Ann. Otol., Rhin. & Laryng.* **69**: 1114-1126, December 1960 (Graduate School of Medicine, University of Pennsylvania, Philadelphia, Penna.)

The author reviews the anatomy and physiology of the area about the cardio-esophageal junction, with particular attention to the congenitally short esophagus and hiatus hernia. In spite of the fact that there is a marked difference between the two conditions, many clinicians are of the opinion that congenitally short esophagus may be nothing more than an accentuation or variation of the usual type of hiatus hernia.

Congenitally short esophagus represents an embryological agenesis of the subtracheal segment of the esophagus, which has been replaced by a fixed segment of stomach in the thorax. The incidence of true congenitally short esophagus is less than 4 per cent, and in at least 50 per cent of the persons thus afflicted esophageal symptoms develop so that the condition becomes apparent either shortly after birth or in the first five years of life. In another 25 per cent symptoms appear before the second decade; in the remainder manifestations may be delayed until much later in life.

Hiatus hernia, on the other hand, results from a defect in the opening of the diaphragm, which allows the stomach to slide into the lower chest cavity. The weakness of the diaphragmatic ring may be present at birth, but in 95 per cent of cases it is an acquired condition. The incidence is less than 2 per cent in the first five years of life, gradually increasing to 5 per cent at fifteen years of age, and to 20 to 25 per cent by the fourth and fifth decades. The author believes that the incidence of true hiatus hernia, in all age groups, is higher than is generally reported in the literature, most likely between 25 and 30 per cent. In true congenitally short esophagus, no alteration occurs in the position of the intrathoracic stomach whether the patient is upright or in Trendelenburg position. This is an important differential point.

The author proposes the term "gastrosia" (gastric mucosa) of the esophagus be used to designate the congenitally short esophagus since the lower end of the

esophagus is completely replaced by gastric mucosa. Peptic esophagitis in varying degrees is practically always associated with gastroesophagitis of the esophagus and may or may not occur in hiatus hernia. Bleeding is a more frequent complication of gastroesophagitis than of hiatus hernia.

True hiatus hernia can be treated surgically, usually with relief of distress. Operative procedures in congenitally short esophagus may not contribute to the amelioration of symptoms and in fact may make them worse. It is therefore important that the two conditions be distinguished.

Two illustrative case histories are summarized.

Ten roentgenograms. JAMES W. BARBER, M.D.  
Cheyenne, Wyo.

**A Classification of Esophageal Hiatus Hernia with Special Reference to Sliding Hernia.** Geoffrey Hagarty. *Am. J. Roentgenol.* **84**: 1056-1060, December 1960. (26 East Parade, Eastwood, N.S.W., Australia)

The classification of esophageal hiatus hernia and the terms "sliding hernia" and "congenital hernia with short esophagus" derived from the work of Åkerlund (*Acta radiol.* **6**: 3, 1926) are regarded by the author as misleading. The hernia rarely slides, the esophagus is hardly ever short in uncomplicated cases, and congenital hernias are extremely rare. While few hiatus hernias are completely reducible, they may appear to be so, and it is this fact which is responsible for the fallacy of the diagnosis of sliding hernia. The term "short esophagus type" implies a condition which is generally found only at operation. The esophagus may appear short, but it is a strongly muscled tube which, according to surgeons, can usually be drawn down under the diaphragm at operation.

On the basis of a roentgenologic study of 200 cases, the following classification is proposed: bell hernias (86 per cent), paraesophageal hernias (8 per cent), and massive hernias (6 per cent). It is suggested that this descriptive classification will lead to a better understanding of the problems involved.

In the *bell hernia*, the stomach pouch appears to hang like a bell from the lower end of the esophagus. These pouches, although usually not of great size, often are not reducible. The distinguishing feature is the centrally placed esophagus which gives the false impression of being short. Bell hernias tend to collapse and empty themselves when the patient is erect, making examination in the recumbent position necessary for their demonstration.

*Paraesophageal hernias* are of two types, those in which there is a normal esophageal position and those in which the esophagus is elevated. The latter is much more common. The term paraesophageal is most suitable as applied to these hernias, since the sweeping curve of the esophagus as it passes down beside the stomach pouch is very characteristic.

*Massive hernias* are usually formed by a paraesophageal-type hernia enlarging and moving upward until the greater part of the stomach is within the thorax; they may swing over to the right and may even become inverted. The esophagus is never centrally placed at the upper extremity of the viscous, as in the bell type. Massive hernias, in the absence of incarceration or obstruction, are less likely to produce symptoms than bell hernias and are often first detected on a mass chest survey. When very large, these sacs may con-

tain omentum, transverse colon, and other viscera, although this is unusual.

Five roentgenograms; 3 drawings.

JOHN A. CAMPBELL, M.D.  
Indiana University Medical Center

**Electrocardiographic and Radiological Studies in Hiatus Hernia.** J. B. McGuinness and S. D. Scott. *Brit. Heart J.* **22**: 629-634, November 1960. (Western Infirmary, Glasgow, Scotland)

Because of an increased awareness of the existence of hiatus hernia and, as a result, the employment of special techniques for its demonstration, hiatus hernia is being observed by radiologists more frequently than in the past. Chest pain and flatulence are often prominent in both hiatus hernia and ischemic heart disease, and both of these conditions occur most commonly in the older age groups. In view of the obvious difference in prognosis and management of these two conditions, it is important that they should be clearly differentiated. A study was made of a random group of patients known to have hiatus hernia to determine the effect on the electrocardiogram of a hernia distended by barium emulsion.

The group included 16 women and 4 men. At the time of the examination, the hemoglobin value was normal in all. This was considered important, since anemia has been shown to have an effect on the electrocardiogram. An electrocardiogram was taken with the patient in the supine position on the x-ray table, before and after drinking a pint of a fairly thick barium mixture. During fluoroscopy after the emulsion was swallowed, the hernia was dilated to the maximum size possible by simple abdominal pressure. The size of the hernia was measured and its type recorded.

Eleven hernias were classified as large, i.e., projecting more than 5 cm. above the diaphragm; 5 of these were sliding, 1 rolling, and 5 mixed.

In 6 of the 20 patients, electrocardiographic changes were found upon distention of the hernia with barium. These changes involved Lead III in particular. It is concluded that in the presence of a full hiatus hernia, alterations may occur in the electrocardiogram. These are attributed to positional changes and are considered unlikely to be confused with those of ischemic heart disease.

Three electrocardiograms; 1 table.

RICHARD A. ELMER, M.D.  
Atlanta, Ga.

**Prolapse of the Mucosa at the Esophagogastric Junction.** Alfred A. de Lorimier and James P. Warren. *Am. J. Roentgenol.* **84**: 1061-1069, December 1960. (J.P.W., Franklin Hospital, San Francisco, Calif.)

The authors report 4 cases illustrating different types of prolapse of the mucosa at the esophagogastric junction: (1) occurring independently though simulating an inflammatory process or neoplasm; (2) in association with esophagitis; (3) redundancy of the mucosa with retrograde prolapse, the etiology of which was apparently a disturbance of deglutition physiology; (4) in association with hiatus hernia.

The incidence of prolapse of the mucosa at the esophagogastric junction is probably greater than reports in the literature would indicate. Recognition of this condition is important. It may occur merely as a result of a disturbance in physiology and may mimic organic disease by symptoms such as substernal pain.

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dysphagia, regurgitation, and perhaps even lassitude or debility. Or lesions such as peptic ulcer, coexistent with prolapse at the esophagogastric junction, are likely to consume the attention of the physician and the prolapse may be overlooked.

The direction of prolapse at the esophagogastric junction may be "prograde" or "retrograde." Either may produce clinical manifestations. Prograde fixation of the mucosal folds may defy definite distinction of prolapse from neoplasm at the fundus of the stomach, and surgical exploration may be required. Retrograde prolapse may be mistaken for a "sliding hiatal hernia" and lead to unnecessary surgery.

Meticulous roentgenoscopic studies, including spot roentgenograms of the esophagogastric junction (with patient upright, prone, and supine), together with greater employment of esophagoscopy, should serve to identify prolapse of the mucosa more often. In the differential diagnosis the following conditions may be considered: esophagitis, peptic ulcer, neoplasm at the fundus or esophagogastric junction; hiatal herniation; esophagospasm; extrinsic pressure defects.

Ten roentgenograms. L. RAY STEWART, M.D.  
Indiana University Medical Center

**Acute Upper Gastrointestinal Bleeding Roentgenologically Considered. Experience at the Hartford Hospital.** Gilbert W. Heublein, Gerald L. Baker, and Robert H. Roy. *Am. J. Roentgenol.* 84: 1003-1027, December 1960. (85 Jefferson St., Hartford 6, Conn.)

After a brief historical note concerning the value of the roentgen examination in the diagnosis of upper gastrointestinal bleeding, the authors discuss the medical and surgical aspects of the problem. They call attention to the facts (1) that about 25 per cent of patients with upper gastrointestinal hemorrhage will give no previous digestive history; (2) that multiple bleeding episodes suggest erosive gastritis; (3) that the vast majority (80-85 per cent) of instances of upper gastrointestinal bleeding are due to peptic ulcer, gastritis, and varices of the esophagus; (4) that a negative bromsulphalein test virtually excludes the possibility of varices; (5) that approximately 20 per cent of patients with upper gastrointestinal tract bleeding will have serious hemorrhage; (6) that the mortality rises sharply in those cases of serious hemorrhage operated upon after forty-eight hours.

The roentgen technic employed by the authors in examining the upper gastrointestinal tract in cases of upper gastrointestinal hemorrhage is as follows: The procedure is performed in the recumbent position with little or no palpation. The esophagus is studied in three positions, with both thick and thin barium. The stomach is examined with the patient in the right postero-oblique position (Schatzki's method). The duodenal bulb is examined in the extreme right posterior oblique position and again after rotation to the left so as to obtain an air-contrast view (Hampton technic). Routine Bucky films are then obtained.

The authors reviewed the charts of all patients admitted to the Hartford Hospital (Hartford, Conn.) with upper gastrointestinal bleeding during 1957 and 1958. During this twenty-four month period 208 cases were found; these were arbitrarily divided into three clinical categories, according to the degree of bleeding activity as 1-plus, 2-plus, and 3-plus. The present study concentrates on the 166 patients, with 2-plus or 3-plus bleeding. Forty-seven of this number

(28.3 per cent) required definitive surgery; the remainder were treated medically. The more active the bleeding, the more frequently surgical intervention became necessary. In the surgically managed patients the interval between admission and completion of an upper gastrointestinal study averaged sixty hours as compared to seventy-three hours in the medical group. The roentgen examination was performed within twenty-four hours in 24 per cent and within seventy-two hours in 64 per cent of the patients. Eighteen patients were operated upon without benefit of an immediate upper gastrointestinal study, but 11 of these had had roentgen examinations previously which demonstrated the probable site of bleeding, and in all 11 the roentgen diagnosis was confirmed at surgery. Thus, 40 of the surgically managed group were examined before surgery and the roentgen diagnosis was confirmed in 34 (85 per cent). In only 3 patients was no bleeding point found. A high percentage of the patients in the medical group had upper gastrointestinal roentgen studies. However, the number of cases in which the final diagnosis was based upon the roentgen diagnosis was relatively small—54 cases (51.4 per cent). Actually, if the roentgen diagnosis of "deformed and irritable bulb without definite evidence of ulcer" was listed as duodenal ulcer, the accuracy of roentgen diagnosis would approximate 84 per cent in the medical group and 82 per cent for the series as a whole. There were 8 deaths, giving an overall mortality of 5 per cent. The average age of the patients that died as a result of their upper gastrointestinal hemorrhage was seventy-six years.

Twelve illustrative cases are reported, with interesting comments following each one, e.g., (1) Varices are difficult to visualize in actively bleeding patients. (2) Gastric carcinoma is rarely responsible for massive bleeding. (3) Medial notching of the first portion of the duodenum is a positive roentgen sign of postbulbar ulcer. These cases serve to emphasize that in the increasingly important problem of upper gastrointestinal hemorrhage it is important to "walk by sight and not by faith" (Moynihan, 1923).

Twenty-seven roentgenograms; 1 photomicrograph and 1 photograph in color; 6 tables.

PHILIP B. SISK, M.D.  
Indiana University Medical Center

**Gastric Mucosal Pattern. A Comparison of the Radiological Pattern of the Gastric Mucosal Folds with the Histological Findings by Biopsy.** N. Henning, K. Heinkel, and W. Frik. *German M. Monthly* 5: 408-413, December 1960. (Krankenhausstrasse 12, Erlangen, Germany)

A comparison was made of the radiological pattern of the gastric mucosal folds with the histologic findings by suction biopsy in 876 patients in whom the interval between the two procedures had been less than fourteen days. The patients were studied both by fluoroscopy and spot-film radiography. When the majority of the folds over a large portion of the stomach—body or antrum—could not be partly or completely effaced and when their width was also increased, the designation "enlargement of the gastric rugae" was applied. Another important radiologic sign was variation in the caliber of the gastric rugae, i.e., several sections, about 0.5 to 2 cm. in length, of several folds in one portion of the stomach were at least one-third wider than the adjacent portions of the same folds. This sign was



considered only in cases without enlargement of the rugae.

The histologic appearances of the mucosa were classified as follows:

1. Normal mucosa
2. Mucosa still normal but with minimal changes in the surface epithelium, some widening of the lamina propria, but without marked cellular infiltration
3. Moderate chronic superficial gastritis
4. Severe chronic superficial gastritis
5. Moderate atrophic gastritis
6. Severe atrophic gastritis
7. Acute inflammatory exacerbation

In this series of 876 patients, there was definite enlargement of the rugae in 20 cases only, mainly in the body of the stomach, and doubtful enlargement in another 29. The total incidence of enlargement was thus about 5.6 per cent. Variation in the caliber of the gastric rugae occurred as a definite finding in 1.95 per cent and as a doubtful finding in 4.1 per cent. The incidence of definite enlargement of the gastric rugae was only slightly higher in the groups with moderate and severe superficial gastritis (3.5 per cent) than the overall incidence (2.3 per cent). The lowest incidence was in the histologically normal group (1.6 per cent); the incidence in the various grades of atrophic gastritis (2.2 per cent and 1.9 per cent) was also slightly below the overall figure. Variation in caliber of gastric rugae followed a similar pattern.

Of the 876 patients, 132 showed an acute exacerbation of chronic gastritis histologically; in 106 there was radiologically no mucosal ulceration. Apparently the radiologic pattern often remains within normal limits despite chronic gastritis with an acute exacerbation. In the groups with definite enlargement of the gastric rugae or with definite caliber variation, there were 20 patients with an acute exacerbation of gastritis, an incidence of 28 per cent.

No correlation was found between the radiologic pattern and sex or age or the nature of the upper abdominal symptoms, if any. Nor was there any correlation between the radiologic signs and the acid-secreting capacity.

Radiologic enlargement of the gastric rugae (detected in 15 cases) and rugal caliber variation (16 cases) was only slightly more common in patients with a gastroscopic picture of so-called hypertrophic gastritis than in gastroscopically normal patients and in those with superficial gastritis. In atrophic gastritis, radiologic enlargement of the gastric rugae was observed only once.

Of 112 patients who had coarse rugae on gastroscopy, only 8 had definite and 11 had doubtful rugal enlargement radiologically. Out of 106 patients who exhibited variation in rugal caliber on gastroscopy, only 3 showed definite and 5 showed doubtful radiologic enlargement of the rugae, whereas 5 showed definite and 7 showed doubtful variation in fold-caliber. The correlation between gastroscopically coarse folds and radiologic enlargement of the folds appears closer than that between any of the other signs studied, but it is not statistically significant.

The authors conclude that the mucosal pattern seen in the radiologic examinations does not reflect the histologically defined changes in the gastric mucosa in gastritis. Radiologic alterations in the mucosal pat-

tern cannot be accepted as evidence of gastritis; the misleading radiologic diagnoses of "gastritis," "hypertrophic gastritis," and "atrophic gastritis" should therefore be discarded.

Five roentgenograms; 5 photomicrographs; 2 tables.

JOHN P. FOTOPoulos, M.D.

Northwestern University Medical School

**Roentgenologic Surveys for Gastric Neoplasms. Report of 31,895 Examinations.** Robert S. Sherman and Ruth E. Snyder. *J.A.M.A.* 174: 949-956, Oct. 22, 1960. (444 E. 68th St., New York 21, N. Y.)

The authors compare the results of fluoroscopic and photofluorographic gastric surveys of asymptomatic patients, with a combined total of 31,895 examinations. Both methods disclosed about the expected number of gastric tumors or tumor suspects. A total of 5/121 fluoroscopic examinations were performed, and 12 tumors were detected. If something unusual was visualized in the stomach during fluoroscopy, the patient was told at once by the roentgenologist that a gastrointestinal series should be done promptly; 86 gastrointestinal series were ordered. The fluoroscopic survey was uniformly successful in bringing all patients with tumors to operation. This was largely due to the close patient-doctor relationship inherent in the method. In 11 of the 12 patients a tumor was found at operation, and in 3 it proved to be malignant. All patients were living and well after five years.

A total of 26,875 photofluorographic examinations were made. Of 579 patients advised to have a gastrointestinal series, 564 returned for this examination. Forty-eight patients were found to have evidence of neoplasm or other serious abnormality. Seventeen of the 48 patients came to operation, and 4 of this number had cancer.

Radiation exposure to patients and to examiners need not constitute a hazard in either method.

Of the two procedures, the authors prefer fluoroscopy because the examinations are easier to conduct and promote better patient-physician relationship should further investigation be required. They believe that radiologists should initiate gastric surveys of asymptomatic patients on the local level, employing the facilities and resources that are available in most hospital x-ray departments. The lack of success of gastric roentgenologic surveys usually is related to organizational practices and not to the tumor detection capabilities of either the fluoroscopic or the photofluorographic method.

Seven roentgenograms; 9 tables.

D. I. COPE, M.D.

Mercy Hospital, Pittsburgh, Penna.

**Hydrochloric Acid Burns of the Stomach.** Arthur S. Tucker and Edwin W. Gerrish. *J.A.M.A.* 174: 890-893, Oct. 15, 1960. (2065 Adelbert Rd., Cleveland 6, Ohio)

The ingestion of caustic acid produces changes in the gastrointestinal tract quite different from those caused by strong alkalis. Either acid or alkali ordinarily results in a stomatitis and inflammatory reaction of the tongue and pharynx. In the case of alkalis, the major damage is usually in the esophagus, while with acids it is usually in the stomach. The anatomic separation of the sites of maximum injury by alkalis and acids, however, is statistical and by no means absolute.

Two cases are reported. Both patients were children.

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twenty-three months and four and a half years of age, respectively, who had drunk hydrochloric acid. Both patients exhibited initial symptoms due to burning of the mouth, followed by gagging and vomiting. Under treatment, the acute reactions subsided but several weeks later vomiting recurred and became persistent. In the first patient, roentgen examination revealed a severe constriction of the proximal part of the stomach and some constriction of the antrum; the esophagus appeared normal. Serial roentgen studies in the second patient showed progressive constriction of the distal part of the stomach and an esophageal stricture. Surgical resection to relieve the obstruction was necessary in both patients.

Six roentgenograms

JOHN F. RIESSER, M.D.  
Springfield, Ohio

**Anterior Subphrenic Abscess Due to Perforated Gastric Ulcer: Value of the Supine Lateral (Cross Table) View.** R. John Gould, Irvin I. Kricheff, and Bernard P. Widmann. *Am. J. Roentgenol.* **84**: 1076-1081, December 1960. (Philadelphia General Hospital, Philadelphia 4, Penna.)

Two cases of posterior perforation of a gastric ulcer associated with left anterior subphrenic abscess are reported, and the probable mechanism of occurrence is discussed. In each of the authors' cases, erect and lateral decubitus roentgenograms showed two air-fluid levels in the left upper quadrant. One fluid level was in the stomach; the other was initially interpreted as an abnormal air-fluid collection in the lesser sac, but a supine lateral (cross-table) view of the abdomen placed it anterior to the stomach. Upper gastrointestinal examination was limited in both cases due to the patients' serious condition and the gastric ulcer was not demonstrated during the acute illness. The hazard of a barium study in the patient with perforation is commented upon. The importance of a supine lateral roentgenogram of the abdomen in locating a subphrenic collection is stressed.

Ten roentgenograms.

RICHARD M. COLBERT, M.D.  
Indiana University Medical Center

**Improved Distensibility and Visualization of the Stomach and Duodenal Bulb.** George N. Chucker and Alvin William Finestone. *Virginia M. Monthly* **87**: 699-703, December 1960. (Clifton Forge, Va.)

The authors describe a simple and safe procedure for increasing the diagnostic accuracy of the upper gastrointestinal radiographic study. A powder is made up of equal parts of sodium bicarbonate and tartaric acid. With the patient upright 1/4 to 1/2 teaspoon of the dry powder is placed on the tongue, followed with a 1 ounce swallow of water. The powder dissolves readily producing carbon dioxide gas. Subsequent double-contrast examination is performed after ingestion of a few ounces of ordinary barium mixture. The mechanics of the fluoroscopic examination are those usually followed, with films made in various positions to take advantage of double-contrast techniques. With the method described the authors can demonstrate distensibility of any segment of the upper gastrointestinal tract and can frequently improve visualization remarkably. Convincing radiographic reproductions are included.

JAMES W. BARBER, M.D.  
Cheyenne, Wyo.

**Pyloric Channel Ulcer. Radiologic Aspects.** Arno W. Sommer, Donald N. Dysart, and Richard D. Haines. *J.A.M.A.* **174**: 1818-1823, Dec. 3, 1960. (213 West Ave. G, Temple, Texas)

A study of pyloric channel ulcer was undertaken at the Scott and White Clinic, Temple, Texas, (1) to determine if there is a symptom complex characteristic of pyloric channel ulcer, (2) to evaluate the accuracy of the roentgen diagnosis, and (3) to survey the results of treatment. The term pyloric channel is used here to designate the narrow area, normally about 1 cm. in length, between the stomach and duodenum, which is visible at fluoroscopy and on roentgenograms. From January 1952 to May 1960, a diagnosis of pyloric channel ulcer was made roentgenologically in 78 cases; in 5 of these, it proved to be incorrect.

Thirty-nine patients had pain which was typical of peptic ulcer, while 34 had atypical pain. Nausea and vomiting were the chief presenting symptoms in 29 patients. Nineteen had episodes of hemorrhage or melena. It was concluded that from the standpoint of symptoms alone, pyloric channel ulcer cannot be distinguished from uncomplicated gastric or duodenal ulcer.

Ulcer of the pyloric channel probably can be diagnosed more accurately by roentgen methods than by any other means, including exploratory laparotomy. Errors in diagnosis may involve (1) failure to recognize a defect in the pyloric channel as an ulcer crater; (2) failure to visualize a crater because of partial or complete obstruction at the pylorus which prevents filling with barium; (3) failure to localize the crater accurately because of distortion of the pylorus and adjacent structures.

Twenty-one of the 78 patients in the present series were treated surgically, and in 16 the diagnosis of pyloric channel ulcer was confirmed. One of the 5 remaining patients was found to have a marked deformity of the duodenal bulb, a crater in the distal portion of the duodenal bulb, and a defect in the pyloric channel from a previous pyloroplasty; 4 patients had penetrating ulcer craters of the posterior surface of the duodenal bulb with firm fixation to the pancreas. Fifty-seven patients were managed medically; over half of those with adequate follow-up studies have shown clinical and roentgen evidence of cure.

Five roentgenograms; 1 photograph; 1 photomicrograph; 7 tables.

JOHN F. RIESSER, M.D.  
Springfield, Ohio

**The Hofmeister Defect. A Normal Change in the Postoperative Stomach.** Mary S. Fisher. *Am. J. Roentgenol.* **84**: 1082-1086, December 1960. (VA Hospital, Philadelphia, Penna.)

In a small percentage of patients who have had a gastrectomy with a Hofmeister type of anastomosis, roentgen examination shows a filling defect on the lesser curvature and posterior aspect of the gastric stump, just above the anastomotic site. It may have a diameter as great as 5 cm. This defect is most prominent on the first postoperative roentgenogram and in many instances has shrunk or disappeared on later studies. The apparent mass corresponds to the invaginated gastric wall. Its prominence immediately after surgery and subsequent subsidence in many cases indicate that it is for the most part the result of edema at the site where the stomach wall is inverted.

The author presents 6 cases which showed this ab-

normality from among 100 patients who had a Hofmeister operation. The initial postoperative upper gastrointestinal examinations were made two weeks or longer after surgery. In 2 cases, a second study showed disappearance of the defect at three and seven months postoperatively. In the remaining case it was still present, though smaller, on follow-up examinations at seven months to four years.

Similar defects are seen following other types of anastomosis, and it is important that they be recognized and distinguished from recurrent or primary tumor and other mass lesions of the fundus.

Fourteen roentgenograms; 1 drawing.

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**Tumor-Simulating Deformities After Subtotal Gastrectomy. A Study of the Problems of the Deformities of the Postoperative Stomach Produced by Operative Distortions Which Give the Appearance of Tumor Growths.** Leon Sasson. J.A.M.A. 174: 280-283, Sept. 17, 1960. (1475 Grand Concourse, New York 52, N. Y.)

In the patient who has had a subtotal gastrectomy, a gastrointestinal series often reveals filling defects and contour irregularities in the gastric remnant which may represent a new or recurrent neoplasm or an operatively produced deformity of the stomach.

In 3 of 4 cases reported here, a gastrointestinal series performed months or years after a subtotal gastrectomy disclosed a filling defect in the gastric remnant which might be due to neoplasm, hypertrophic rugae, or to postoperative distortion. Gastroscopy showed that the areas of distortion were due to plication deformities, producing heavy ridges or bulging folds covered by gastric mucosa, and further operation was avoided. In the fourth case roentgen examination revealed a rather large, round filling defect in the fundus of the stomach, with a suggestion of barium in the center. This was interpreted as an ulcer crater on the surface of a neoplasm. Gastroscopy showed a lobulated mass rising from a broad base at the greater curvature aspect of the fundus, protruding into the lumen of the stomach. No ulceration was seen. A diagnosis of adenoma was made. On laparotomy, a tumor-like mass was found in the fundus, which appeared to be covered by normal mucosa. Biopsy revealed normal mucosa and muscle. The surgeon felt that the mass represented a postoperative deformity caused by the suture ridge.

The author believes that in many cases gastroscopy and laparotomy could be avoided if routine gastrointestinal series were made on the postoperative patient prior to, or shortly after, discharge from the hospital. This would make available roentgenograms of the various surgically created plications, bulging folds, and distortions, for future reference.

Six roentgenograms. MICHAEL LAZOREK, M.D.  
St. Vincent's Hospital, New York

**The Zollinger-Ellison Syndrome.** William S. C. Hare. J. Coll. Radiologists Australasia 4: 84-87, December 1960. (Royal Melbourne Hospital, Victoria, Australia)

The Zollinger-Ellison syndrome comprises primary peptic ulcerations in unusual locations, gastric hypersecretion, and a nonspecific islet-cell tumor of the pancreas. After describing the syndrome in some detail

the author reports a case which presented no evidence of a pancreatic tumor but otherwise appeared consistent with this diagnosis.

The tumors which have been regarded as one of the triad of features of the syndrome arise from the alpha cells of the islets of Langerhans. There is no evidence at present to indicate that a humoral agent secreted by these tumors is responsible for the stimulation of gastric secretion leading to the ulcerative lesions. Actually, glucagon, which is known to be secreted by alpha cells, inhibits gastric secretion.

The majority of tumors occur in the body and tail of the pancreas. They may be multiple, and a considerable number are malignant. Ectopic tumors occur about the pyloric antrum, in the wall of the duodenum, and at the hilus of the spleen. In instances when pancreatic tumors could not be demonstrated, a general hyperplasia of the islet cell tissue has been found. However, in the case reported here, as well as in one other, the pancreas appeared normal, although it is difficult to exclude the possibility of an ectopic tumor in such instances. In approximately a quarter of the reported cases, the syndrome has been part of a multiple endocrine adenopathy (pituitary overaction, hyperparathyroidism, tumor of adrenal cortex).

Gastric hypersecretion may reach gigantic proportions and is of high acidity. A total gastrectomy is strongly recommended because even a small remnant of gastric mucosa may be responsible for large volumes of extremely acid juice.

The ulcers, considered to be consequent upon the high levels of gastric secretion, occur in the classical situations in the stomach and first part of duodenum. Especially characteristic are the distal ulcers in the jejunum.

Diarrhea is commonly an initial complaint. Movements are watery and foul-smelling. The cause of the diarrhea remains unexplained.

**Abnormal small-bowel pattern:** The mucous membrane has a lace-like or a cobweb-like appearance. Due to the broadening of the valvulae conniventes, this appearance may be diagnostic, and radiologists should bear it in mind during barium-meal examinations.

One roentgenogram; 2 drawings. S. ASMAR, M.D.  
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**The Small Intestine Transit Time with a Physiologic Contrast Medium.** O. Mattsson, Gunvor Perman, and H. Lagerlöf. Acta radiol. 54: 334-344, November 1960. (Karolinska Sjukhuset, Stockholm, Sweden)

The transit time through the small intestine studied roentgenologically with conventional barium suspension shows great variations in normal persons. Barium meals containing food have been employed, but there has been no standardization of the method and little information has been obtained concerning the main problem, which is the rate of passage of food and not of a contrast medium through the small intestine. The authors have evolved a "physiologic contrast medium" which provides a fixed amount of fat, carbohydrate, and protein and fulfills the following criteria: stability, homogeneity as a mixture, and accuracy in depicting morphology. The medium consists of a barium sulfate preparation with low sedimentation properties and a homogenized water suspension of corn oil, skim milk powder, dextrose, polyethylenglycol, and serum albumin. A 300 ml. meal was employed in

each examination and its passage through the stomach and small intestine was documented by roentgenograms obtained at fixed intervals. The speed of transportation of the test meal was analyzed by recording: (1) when the first portion had reached the L5-S1 level, (2) when the fundus of the cecum was filled, (3) when the stomach was completely empty, and (4) when all the contrast material had reached the colon.

Normal values were based on the findings in 30 patients, ranging in age from seventeen to seventy-one years. The first portion of the meal ran rapidly through the small bowel, and at fifteen minutes had already reached the true pelvis, with a small amount of the meal being regularly distributed between that region and the stomach. Later, the small intestine filled up more and more, mainly by an increase in its lumen. After about two hours the meal started to enter the colon. The stomach was empty after about four hours, and transit through the small bowel was completed after six hours. Results obtained in the present investigation were surprisingly uniform.

In 4 patients with total gastrectomies, the meal had reached the L5-S1 level within fifteen minutes of ingestion, as in normal patients. In 3 of the patients, the fundus of the cecum was reached more rapidly than in any of the normal persons. It took longer for the entire meal to leave the small intestine than in the normal group.

In 18 patients with partial gastrectomy, the gastric remnant was empty after about three hours. In 12 with moderate or marked dumping, the cecum was reached in fifteen to thirty minutes; in 6 without the dumping syndrome, behavior was as in the normal group. The whole meal left the small intestine in six to eight hours, the somewhat longer times being in the patients with dumping symptoms.

Seventeen patients with steatorrhea were examined. On an average, the contrast meal reached the cecum more slowly than in the other groups studied, and the total transit time was also prolonged.

The small-intestine transit time in 8 cases of ulcerative colitis did not differ significantly from that in the normal group.

The authors stress the influence of psychological factors on small-intestinal motility and the importance of a calm and unhurried atmosphere during the examination.

Five figures, including 30 roentgenograms; 1 chart; 2 tables.

RALPH SCHLAEGER, M.D.

Columbia University, New York

**Duodenal Stasis.** André M. Fournier and Claude Guen. *J. de radiol.* 41: 757-768, December 1960. (In French) (Hôpital de la Conception, Marseille, France)

Observation of duodenal stasis calls for careful attention to determine the presence of distinct dilatation, alteration of the mucosal relief, and modification of contour. Cases are classified as *functional*, *organofunctional*, *organic*, and *idiopathic* stasis.

*Functional* duodenal stasis follows the administration of morphine, atropine, or other drugs which affect motility, and it is seen in hypothyroidism, after vagotomy, or as a complication of a lesion of the central nervous system. Diabetes, porphyria, scleroderma, lupus, and purpura may be accompanied by duodenal stasis.

Afferent loop stasis after partial gastrectomy or

vagotomy may result in *organofunctional* stasis, as may duodenal ulcer and diverticulum, cholecystitis, and acute and subacute pancreatitis. Chronic pancreatitis is not associated with stasis but may cause an impression on the medial wall of the descending portion of the loop. Renal inflammation may cause a reflex stasis.

*Organic* stasis is caused by congenital lesions (duodenal diaphragm, stenosis, adhesive bands, or annular pancreas); extrinsic compression (superior mesenteric artery, tumors of pancreas, kidney, colon, or enlarged nodes); intrinsic duodenal lesions (ulcer of the second portion, benign and malignant tumors, foreign bodies); surgery in the region of the duodenal loop.

Those cases of duodenal stasis with dilatation of unknown cause are listed as *idiopathic*. Two instances are cited, 1 with dilatation of the first portion of the jejunum and 1 with dilatation of the esophagus and jejunum.

Twenty-two roentgenograms.

CHARLES M. NICE, JR., M.D., Ph.D.  
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**Roentgenographic Considerations in the Differential Diagnosis of Jaundice.** Harold Rosenbaum. *J. Kentucky State M.A.* 58: 1191-1195, October 1960. (University of Kentucky, College of Medicine, Lexington, Ky.)

The author reviews the roentgenographic findings which may prove helpful in the differential diagnosis of jaundice. The findings stressed on plain film studies are: (1) a mass in the right upper quadrant; (2) opaque gallstones; (3) nonopaque stones (so-called gas-containing stones); (4) emphysematous gallbladder; (5) gas within the biliary tree.

Among helpful contrast studies are oral cholecystography and intravenous cholangiography (visualization of bile ducts and/or gallbladder should be expected in one-fifth to two-thirds of cases with serum bilirubin of less than 5.0 mg. per cent). If an increase in density is noted in the gallbladder two hours after injection of the medium when compared to the one-hour film, an incomplete obstruction of the common duct should be suspected. Lateral curving and displacement of the common duct have been described in carcinoma of the head of the pancreas. The four-day Telepaque test of Salzman is useful in identifying common-duct and intrahepatic calculi. An upper gastrointestinal series may disclose (a) varices, indicative of cirrhosis; (b) deformity, displacement, or widening of the duodenal cap, suggesting pancreatic neoplasm; (c) downward and medial displacement of duodenal loop and bulb indicative of congenital choledochal cyst if other clinical features are consistent with this etiology. Percutaneous splenoportography may be helpful in the diagnosis of cirrhosis and space-occupying lesions in the liver.

Six figures.

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**The Influence of Different Contrast Media for Cholangiography on Blood Pressure and Pulse Rate.** Georg-Fredrik Saltzman and Karl-Anders Sundström. *Acta radiol.* 54: 353-364, November 1960. (Serafimerlasarettet, Stockholm, Sweden)

By measuring blood pressure and pulse rate, the authors have determined the circulatory effects of different contrast media used in cholangiography, in an unselected series of cases. Percutaneous catheterization of the brachial artery was employed, with continu-



ous monitoring of pressure by means of a Swema-Elema strain-gauge transducer and a four-channel recorder. Systolic pressure determinations were begun one minute prior to the administration of the contrast medium and were continued for at least twenty minutes. Pulse rates were calculated from a single lead electrocardiogram synchronous with intra-arterial pressure measurements.

With an intravenous 20-c.c. dose of Biligradin-Forte, there was a decrease in systolic pressure in the 4 to 38 per cent range with an average of 15 per cent. A few patients exhibited a transitory early rise in pressure. The drop in pressure, when measured in absolute figures, was greater in those with higher initial pressures. The greatest pressure fall was observed in the older patients. Generally, the more rapid the injection the greater the drop in systolic pressure and the earlier its appearance in a twenty-minute sequence of recording. The reduced pressure lasted from two to eight minutes and was sustained for a longer period following slow injection. Evaluation of these data was complicated by the effects of nitroglycerine and morphine, which were used in conjunction with the examination. The pulse rate showed a moderate increase in the majority of cases, and this was most marked when the medium was injected rapidly. The mean pulse rate rise was approximately 15 per cent.

No decrease in blood pressure occurred in peroral cholangiography with Solu-Biloptin; on the contrary, there was a mean pressure elevation of approximately 9 per cent. In the 3 cases in which Bilijodon-Natrium was used, no blood-pressure changes exceeding 5 per cent were noted. An insignificant increase in cardiac rate was recorded with the peroral technique.

Attention is directed to the possible hazards of a hypotensive episode incident to intravenous cholangiography in older patients, especially with cardiovascular disease. In younger patients, the authors conclude that Biligradin-Forte is a "harmless" contrast medium in spite of the blood-pressure fall and is, preferable, for examining ducts, to the peroral technique.

A case is reported, by the authors, of transient carotid insufficiency following 20 ml. of Biligradin-Forte in a seventy-two-year old woman with hypertension, atherosclerosis, and auricular fibrillation. Confusion followed by loss of consciousness occurred immediately after the injection. One minute later signs of a left hemiplegia appeared. The systolic pressure drop from the pre-injection baseline was 60 mm. of mercury. Consciousness returned after one half hour and the hemiplegia disappeared completely.

Five figures.

RALPH SCHLAEGER, M.D.  
Columbia University, New York

**Oral Cholecystography and Cholangiography with a New Contrast Medium.** Lidio G. Mosca, Nélida Vanetta de Di Rienzo, Giovanni M. Scavino, and Carlos J. Croppi. *Radiología* 11: 7-20, December 1960. (In Spanish) (Cordoba, Argentina)

The authors relate their experience with biliary tract studies performed in 100 patients with oral Biloptin (sodium beta-propionate). The usual dose was 6 capsules of 500 mg. each. Absorption was rapid, and the biliary tree was usually opaque after sixty minutes. Excretion was largely renal. Side effects, such as nausea, diarrhea, and headache, were not encountered in the series. No opaque intestinal residue was noted.

In 69 of the 100 cases the gallbladder was visualized, and in 66 per cent of these the duct system was demonstrated. It was seen in 42 per cent of cholecystectomized patients. Of 21 patients with nonvisualization after common tri-iodized media, the gallbladder was visualized with Biloptin in 44 per cent.

In the presence of an opacified gallbladder with nonvisualization of the duct system, the authors found the administration of a fatty meal sufficient to delineate the ducts in many cases; in others it was useful to administer 6 more tablets immediately and to take repeat films after an additional interval of three to five hours.

Nineteen figures, including 14 roentgenograms.

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**Solu-Biloptin (SH 550) as a Contrast Medium for Peroral Cholangiography.** Georg-Fredrik Saltzman. *Acta radiol.* 54: 417-425, December 1960. (Seraphim-lasarettet, Stockholm, Sweden)

A new oral contrast medium for demonstration of the bile ducts, Solu-Biloptin, has been investigated and the results have been compared with those obtained with other media. The iodine content of Solu-Biloptin is 61.7 per cent. Adequate contrast density of the bile ducts was achieved in 51 of the 62 patients in whom the medium was employed. In 6 patients the ducts were visible but not distinctly enough for diagnosis, and in the remaining 5 they were not visualized.

The best results were obtained when 6 gm. of Solu-Biloptin were given. The powdered contrast medium was mixed with one or two glasses of ordinary tap water, and all patients swallowed this mixture without difficulty. Side reactions were minimal. No allergic reactions were encountered. No fall in blood pressure of the type produced by Biligradin was recorded. Optimal contrast density in the ducts was reached in the majority of cases within two and a half hours. In only a few instances was the interval longer; in 1 patient, it was five hours.

With all forms of oral cholangiography used up to now—and the Solu-Biloptin method is no exception—the bile ducts may be partially concealed by contrast medium in the pyloric portion of the stomach and in the duodenal bulb. This interference can be readily eliminated with the aid of tomography. The excretion of contrast medium through the kidneys sometimes causes difficulties in the interpretation of the bile ducts in intravenous cholangiography, especially if an overdose of the contrast material has been given. This is not the case with Solu-Biloptin, since excretion with the urine takes place so slowly that contrast filling of the renal pelvis is not often observed.

Solu-Biloptin has improved the possibilities for examining the bile ducts with oral media. Its rapid transport to the site of absorption in the small intestine constitutes the most notable advantage offered by this preparation over other contrast agents. An examination with Solu-Biloptin takes longer than intravenous cholangiography with Biligradin, and, in the author's opinion, the latter still holds its position as the most important contrast medium for cholangiography. Peroral cholangiography, however, is preferable in the aged, in patients with cardiovascular disease, and in those who exhibit a positive reaction to a Biligradin test.

Six roentgenograms; 2 graphs.

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**Width of the Common Bile Duct Before and After Morphine Studied by Cholegraphy.** Mats Jonson. *Acta radiol.* **54**: 345-352, November 1960. (Seraphimerlasarettet, Stockholm, Sweden)

The effect of morphine on the width of the common bile duct before and after cholecystectomy was investigated in 200 cases by intravenous cholegraphy with Biligradin-Forte (Cholografon). Interval films were made after injection of the contrast material; morphine was given subcutaneously at fifty minutes, and subsequent records were obtained ten and twenty minutes later. The examination was terminated following the administration of a spasmolytic, Recipavrin, and documentation of the status of the ducts on films five and ten minutes thereafter. Tomography was utilized in the majority of cases while the ducts were under the influence of morphine. Measurements were made at the level of the widest diameter of the duct.

Certain observations relative to duct size were made which are fundamental to the understanding and evaluation of the extrahepatic biliary system. For example, in the nonoperated group, the ducts were wider in cases with abnormal findings than in those with a normal cholegraphic picture. In the surgically treated cases, the ducts were approximately of the same width as in the nonsurgical patients with roentgenologically demonstrable biliary tract disease. Accordingly, the increased width of the duct did not appear to be a coefficient of the surgical procedure but rather a function of the underlying disease requiring operative intervention.

The author directs attention to such side-effects as pain, nausea, and vomiting and to the difficulties in obtaining objective criteria for the diagnostic value of morphine in cholegraphy. In 100 cholecystectomized patients, contrast density of the bile ducts was increased in 49 per cent after morphine, and this was a critical factor in establishing a definite diagnosis in 12 per cent. In cases in which opacification at forty-five and sixty minutes was faint, such increased density of the ducts provided better contrast and, therefore, more diagnostic films, especially when tomography was employed.

In the entire series, which consisted of 100 cholecystectomized patients and 100 with the gallbladder *in situ*, the mean dilatation following morphine was 23 per cent, a value consistent with that obtained by others. The degree of dilatation after morphine and the severity of symptoms did not correlate well in the author's series. Nevertheless, it was observed that pain after morphine tended to occur more often in dyskinesia cases than in others. The author expresses doubt as to the diagnostic significance of dilatation of the bile ducts incident to morphine administration.

Seven tables; one chart.

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**Pseudoalbuminuria Due to Bunamiodyl.** John H. Grimm, Grover C. Wallace, and Barry E. Gerald. *J.A.M.A.* **174**: 1638-1639, Nov. 19, 1960. (1203 Ross Sterling Ave., Houston 25, Texas)

The previously established (1950) finding of pseudoalbuminuria in conjunction with the use of oral gallbladder contrast media prompted testing for this finding after the introduction of bunamiodyl (Orabilex) for general use at the authors' hospital in 1959.

A series of 100 patients was tested, excluding menstruating women and patients with true albuminuria and urinary infections. In 17 of the number pseudo-

albuminuria developed after ingestion of 4.5 gm. of bunamiodyl. The precipitate formed disappeared with heating, which does not occur in the presence of serum albumin. The presence or absence of gallbladder disease did not affect the incidence of pseudoalbuminuria.

The diagnosis of albuminuria in patients who have received bunamiodyl within the preceding four or five days should be guarded, and appropriate steps taken to rule out a pseudoalbuminuria.

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## THE SPLEEN

**Wandering Spleen Diagnosed Preoperatively by Intravenous Aortography.** Morton A. Bosniak and Walter Byck. *Am. J. Roentgenol.* **84**: 898-901, November 1960. (525 E. 68th St., New York 21, N. Y.)

Wandering spleen is a rare condition which is difficult to diagnose preoperatively. Most often it is discovered when torsion of the elongated splenic pedicle results in infarction and acute abdominal pain. The authors report a case diagnosed preoperatively by intravenous abdominal aortography, which clearly demonstrated the splenic artery and the abnormally located spleen.

The patient, a 33-year-old woman, was intoxicated when admitted to the hospital and it was thought that the left abdominal pain of which she complained was of traumatic origin. A roentgenogram of the abdomen revealed an elongated mass of soft-tissue density in the left mid-abdomen with its lower border reaching the iliac crest. The appearance of the soft-tissue density was suggestive of spleen. Laminagraphy of the abdomen was helpful in further defining the size and position of the mass. Diagnostic pneumoperitoneum failed to show a spleen in its normal location. Intravenous aortography clearly demonstrated that the left midabdominal mass was spleen and that the splenic artery was elongated and tortuous. The diagnosis was confirmed at surgery.

Because of the serious complications associated with wandering spleen, it is important to establish the proper diagnosis with certainty. Roentgenographically, the possibility of this condition can be suspected by routine abdominal examination and with the special techniques of laminagraphy and diagnostic pneumoperitoneum. Failure to demonstrate a normally placed spleen, however, cannot be considered diagnostic of wandering spleen.

Three roentgenograms.

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## THE MUSCULOSKELETAL SYSTEM

**Progress of Medical Science: Radiology. Roentgenographic Manifestations of the Cartilaginous Dysplasias.** John W. Lane. *Am. J. M. Sc.* **240**: 636-670, November 1960. (University of Colorado Medical Center, Denver, Colo.)

A group of similar skeletal diseases manifested primarily as severe disturbances of enchondral bone formation has been described, particularly in the radiological literature. These cartilaginous dysplasias are often difficult to evaluate and classify, and often a clear-cut diagnosis cannot be made without a full

complement of physical, historical, familial, laboratory, and roentgen data.

In his review, the author presents the classical findings of the most important of these diseases as observed on the roentgenogram. The conditions covered are (1) achondroplasia; (2) osteochondrodystrophy (*a*) Morquio type, (*b*) Hurler type, (*c*) Leri type; (3) dysplasia epiphysalis multiplex; (4) dysplasia epiphysalis punctata; (5) dyschondroplasia; (6) multiple hereditary osteochondromata. A brief discussion of the clinical, laboratory, and pathological findings is given with each disease entity.

The remarkable feature of this group of diseases is the wide variety of manifestations produced by the basic, underlying defect of cartilage dysplasia. Many of these conditions have associated abnormalities not directly attributable to faulty cartilage formation or maturation, and these may play an important role in giving rise to the varied appearance of these diseases. The differential diagnosis is not too difficult except within the confines of each group. Occasionally entities such as fibrous dysplasia may be confused with dyschondroplasia. In fibrous dysplasia, however, the diaphyseal distribution, ground-glass appearance of the lesion, scalloping of the inner cortical margin, lack of columnar arrangement of the radiolucent areas, and the tendency toward fracture makes differentiation relatively easy.

The various osteochondritides and aseptic epiphyseal necroses may offer difficulties in differentiation from the epiphyseal dysplasias and even Morquio's disease. However, the associated finding of the latter two diseases helps greatly.

Thirty-one illustrative roentgenograms and photographs are reproduced. A table summarizes the findings in the cartilaginous dysplasias discussed.

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**Intracortical Osteogenic Sarcoma.** Henry L. Jaffe. *Bull. Hosp. Joint Dis.* 21: 189-197, October 1960. (Hospital for Joint Diseases, New York 35, N. Y.)

The usual osteogenic sarcoma of bone starts its development centrally, that is, in the medullary cavity of the affected bone. The cortex then becomes involved, and sooner or later the tumor is likely to extend through the cortex into the overlying soft parts. The term "intracortical osteogenic sarcoma" is used to denote that rare form of osteogenic sarcoma which arises within the cortex of bone. It is not to be confused with "juxtacortical osteosarcoma," which develops in relation to the surface of the bone, specifically in relation to the periosteum and/or immediate parosteal connective tissue. The juxtacortical osteosarcoma has a better prognosis than the conventional (central) type, and the author suspects that the intracortical sarcoma resembles the central rather than the juxtacortical type in this respect.

The author has studied material from 2 cases which may be classified as intracortical osteosarcoma, and 1 of these he reports in detail. The patient was a fourteen-year-old boy with a painful swelling over the left tibia. Roentgen examination showed the cortex of the affected tibia to be greatly thickened for some distance (about 10 cm.) above and below the junction of the upper and middle thirds. The thickening involved the anterolateral surfaces of the bone. At the thickest point, the cortex measured about 2 cm.

Here a roundish area of irregular density stood out in contrast to the rest of the cortex. Roentgenograms of the resected specimen likewise demonstrated this area of somewhat divergent density; on histologic section it was found that the area in question represented the actual intracortical osteogenic sarcoma. The areas of relatively uniform thickening and density above and below it were merely cortical thickening resulting from deposition of subperiosteal new bone as a reaction to the evolving intracortical sarcoma.

X-ray therapy was instituted postoperatively, and it was planned to follow this by amputation. Irradiation with supervoltage (2,000,000 volts) x-rays was given in fourteen treatments over a period of twenty-five days, for a total tumor dose of 5,840 r, but the amputation was refused initially. A staphylococcal osteomyelitis developed. Seven months after the original surgical intervention, there was evidence of local recurrence of the tumor in the tibia. A midhigh amputation was then performed. The time which has elapsed since the amputation is still too short to permit any conclusion about the probable final outcome in this case.

Four roentgenograms; 6 photomicrographs.

JOHN P. FOTOPoulos, M.D.  
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**Cineradiographic Studies of the Normal Cervical Spine.** Malcolm D. Jones. *California Med.* 93: 293-296, November 1960. (University of California School of Medicine, San Francisco 22, Calif.)

Cineradiography with a commercial model Westinghouse Cine Fluorex unit was employed for study of cervical spine motion in 80 patients. Routine flexion and extension studies were also performed in most of this group.

The cervical spine consists of five segments showing the "usual" motions and two transitional vertebrae (the first and the seventh) which may share the motion of the other cervical vertebrae but may also show the motion corresponding to that of the next adjoining area. Thus, in the atlas, motion may mimic that of the axis or of the occiput. The seventh cervical vertebra exhibits less motion than the other cervical vertebrae and thus acts more like the thoracic vertebrae. If the seventh vertebra becomes fixed, the sixth cervical may assume its function. Actions of the atlas, however, cannot be assumed by other cervical segments.

Reversal of the cervical lordosis is a normal part of the flexion action and can result from positioning of the patient. In roentgenograms taken with the patient standing, the amount of posterior bowing of the mid-cervical segment is less pronounced than in those taken in the sitting position. The degree of glide between the vertebral bodies is also curtailed in the standing position, particularly in extension.

A comparison was made between roentgenograms of the cervical spine taken when the neck had been flexed and the chin then pulled in and roentgenograms taken when the chin had been pulled in first and the neck then flexed. Lordotic reversal is more pronounced when the chin is pulled in prior to flexion.

In childhood the upper cervical segment is more active because of the position of the scapula and clavicle. As these bones descend, the midcervical segment assumes the greatest action. Later, as the individual ages and degeneration occurs, the motion once more becomes proportionately greater at the higher levels.

The total motion pattern of the cervical spine of any one person is rather characteristic of that person; there is no one average motion, but rather a range of normal motions.

Cineradiography permits a physiologic evaluation of the cervical spine and is especially valuable when there is difficulty in positioning the patient for routine roentgenograms. Various diseases affecting the cervical spine have been studied and are to be reported subsequently.

Four roentgenograms; 1 drawing.

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**Diagnosis and Treatment of Painful Neurological Disorders Caused by Spondylosis of the Lumbar Spine.** Joseph A. Epstein. *J. Neurosurg.* 17: 991-1001, November 1960. (Long Island Jewish Hospital, New Hyde Park, N. Y.)

Spondylosis, or osteophytosis, begins as a degeneration of the intervertebral disk relatively early in life. Progressive dehydration and fibrillation of the annular fibrocartilage is followed by a loss of turgescence, with thinning and outward bulging of the annulus fibrosus. The connection of the spinal ligaments to the periosteum at the ring epiphysis is loosened, with deposition of new periosteal bone between the elevated periosteum and the original corticalis of the vertebral body. Osteophytes formed in this manner may protrude into the spinal canal and intervertebral foramina, and a significant compression of the soft neural structures traversing them may result. In the lumbar area, the bony changes may be well advanced before neural compression and neurologic symptoms appear. The true extent of stenosis of the spinal canal caused by osteophytes may not be fully appreciated on the plain film because of the presence of unossified osteoid tissue in these structures. Myelography is a possible means of identification under such circumstances.

The findings in 14 patients, all with neurologic changes, are discussed. Roentgenograms of the spine disclosed evidence of spondylosis at either single or, more often, multiple levels in the lower lumbar region. Interspaces were narrowed and osteophytes at the vertebral margins encroached upon the intervertebral foramina. Spondylolisthesis without spondylolysis was apparent in the more advanced cases. In 1 patient, the body of L4 was dislocated anteriorly upon the body of L5, resulting in a complete block within the spinal canal. Plain roentgenograms were reported as "not remarkable" in 2 patients. Myelography revealed a complete transverse block at single or multiple levels in 3 patients, incomplete block in 5, and deformities of the axillary pouch in the remainder. The oil pooled characteristically in the hollow formed by protruding disk tissue and osteophytes, yielding a "washboard" effect. In lateral exposures, the oil presented a teardrop or sinuous, beaded appearance. A toothed pattern was seen in the anteroposterior view, produced by multiple nerve roots projecting into the narrowed column of oil.

Conservative treatment—mobilization and traction—of patients with spondylosis may provide temporary relief. With an advancing neurologic deficit despite such measures, decompression by means of laminectomy and foraminotomy, with removal of osteophytes and ridges, can provide improvement in 50 to 70 per cent. Congenital narrowing of the canal in the lumbar

region, alone or with disk and spondylolytic changes, appears to be a definite but inadequately appreciated clinical entity. In this group of patients, minimal protrusion of disk tissue or spur formation in the ventral quadrants of the spinal canal results in painful and disabling nerve-root compression. Decompressive laminectomy is the treatment of choice.

Seven roentgenograms; 1 drawing.

DON E. MATTHIESEN, M.D.  
Phoenix, Ariz.

**A Review of the Causes of Rib-Notching with a Report of an Unusual Case.** W. Wilson. *Brit. J. Radiol.* 33: 765-769, December 1960. (119 Jessie St., Armidale, N.S.W., Australia)

The causes of rib-notching are reviewed and the following classification is submitted:

1. Vascular rib-notching:

- a. Arterial: Erosion by dilated and tortuous intercostal arteries.
  1. Coarctation of aorta.
  2. Obstruction to subclavian or innominate arteries.
  3. Increased systemic blood supply to lungs in conditions causing pulmonary oligemia.
  4. Systemic supply to a pulmonary arteriovenous fistula.
  5. Arteriosclerosis, hypertension, and conditions causing increased pulse pressure.
- b. Venous: Erosion by dilated and tortuous intercostal veins. Obstruction to superior vena cava, innominate veins, or subclavian veins.
- c. Arteriovenous: Erosion by vascular malformations. Arteriovenous fistulae of intercostal vessels.

2. Neural rib-notching: Erosion by tumors of intercostal nerves. Neurofibromatosis.
3. Idiopathic rib-notching: No underlying cause demonstrated.
4. Pseudo rib-notching: Irregular cortical thickening of long bones occurs in tuberosus sclerosis. When ribs are involved, notching may be simulated.

Although no longer considered a pathognomonic sign of coarctation of the aorta, rib-notching is most commonly caused by that condition.

A case of unilateral rib-notching, associated with a pulmonary arteriovenous fistula, is reported. The notching in this case is attributed to dilated and tortuous intercostal arteries carrying a contributory systemic blood supply to the fistula.

Three similar cases recorded in the literature are mentioned.

Three roentgenograms.

THEODORE E. KEATS, M.D.  
University of Missouri

**Cone-Shaped Epiphyses with Partial Symptoms of the Marchesani Syndrome.** H. H. Thiemann. *Fortschr. a. d. Geb. d. Röntgenstrahlen* 93: 367-370, September 1960. (In German) (Universitäts-Kinderklinik Rostock, Germany)

The "cone-shaped epiphysis" of the proximal phalanx of the second, third, and fourth toes is a rare anomaly. It occurs at the proximal end of the first

phalanx of the toe and consists of a cone-shaped deformity of the proximal epiphysis that fits into a hollow at the proximal end of the diaphysis, the shape of an inverted "V." When the child is grown and the epiphyseal line disappears, there may no longer be any trace of the anomaly. In a number of cases described in the literature, this was apparently the only abnormality present. Brailsford, in his book, described it as "peripheral dysostosis."

The author observed the condition in several cases of Marchesani's syndrome, which is characterized by eye disturbances (microphakia, spherophakia, luxation of the lens, myopia, and secondary glaucoma), brachydactyly with plump hands and feet, and dwarfism, an hereditary syndrome representing a dominant trait. A family is reported in which the father displayed a typical Marchesani's syndrome, and all of his 6 children exhibited at least some phases of it. The cone-shaped epiphysis was seen in 4. The author also saw a six-year-old child in another family with most of the signs of the Marchesani syndrome and with typical cone-shaped epiphyses.

It is concluded that cone-shaped epiphyses represent an hereditary condition often associated with other anomalies. Although it is harmless, it should alert the radiologist to the possibility of more serious irregularities.

Two roentgenograms; 2 photographs; 1 sketch.

WILLIAM A. MARSHALL, M.D.  
Chicago, Ill.

## GYNECOLOGY AND OBSTETRICS

**Holoacardius Monster in Obstetrics.** Vishnu Sarma. *Brit. J. Clin. Practice* 14: 795-800, October 1960. (Government Women and Children's Hospital, Egmore, Madras, India)

[Friedman (*Radiology* 75: 782, 1960), in his discussion on holoacardius acephalus, states that "in the few cases where prenatal roentgen reports are available, a diagnosis of anencephaly was made," as in the case he reported.]

The predelivery roentgen report in the case described here was "twins, both presenting by the breech." The first twin, a premature male weighing 2 lb. 12 oz., was normal in appearance but lived for only a few hours. The monster was delivered by lower cesarean section performed under general anesthesia. It weighed 1 lb. 9 oz. and was made up of a flattened head covered with hair and a single well developed lower extremity.

Retrospective study of the roentgenograms showed a malformed twin coexisting with a twin which looked quite normal in its bony structure. Had the predelivery film been submitted to careful scrutiny, the monster might have been removed piecemeal or by evisceration.

Three roentgenograms; 9 photographs.

## THE GENITOURINARY SYSTEM

**"Uni-Papillary Kidney." An Unusual Developmental Abnormality of the Kidney.** Alan Neal and Leonard Murphy. *J. Coll. Radiologists Australasia* 4: 81-83, December 1960. (St. Vincent's Hospital, Fitzroy, Melbourne, Australia)

A case of uni-papillary kidney, an unusual develop-

mental abnormality, is reported. This abnormality has not been encountered previously in the authors' experience, and a search of the literature failed to disclose a description of a similar condition.

The patient was a seventeen-year-old boy who presented with hypertension, albuminuria, and mild dyspnea on exertion. Intravenous pyelography revealed no evidence of a kidney shadow or of excretion on the left side. On the right, there was a functioning kidney of average size and form, the drainage system of which was bizarre. The renal pelvis was bifid, the larger, medially placed process ending blindly. From the smaller, laterally placed calyx radiating tubules, filled with contrast material, were seen passing peripherally to within a few millimeters of the kidney margin; their caliber was of the order of 0.45 mm. (normal tubules, 0.05 to 0.1 mm.) The kidney thus appeared to be of a uni-papillary type, i.e., tubules converging onto a single papilla. The latter seemed small relative to the bulk of the kidney. Retrograde pyelography showed the left ureter ending blindly at the level of L5. The patient refused to submit to further studies, such as aortography.

The authors are of the opinion that this uni-papillary kidney represented the whole of the right kidney and the only functioning renal tissue present.

Three roentgenograms; 1 photograph; 1 drawing.

A. R. ABLA, M.D.  
Cleveland Metropolitan General Hospital

**Renal Displacement Associated with Enlargement of the Spleen.** William John Forde, David G. Ostrofsky, and Nathaniel Finby. *Am. J. Roentgenol.* 84: 889-897, November 1960. (N. F., 525 East 68th St., New York 21, N. Y.)

In order to assess the frequency of renal displacement associated with splenic enlargement, 552 cases of splenomegaly seen at the New York Hospital between 1952 and 1957 were reviewed. Pyelographic studies were available in only 127 of these patients. Twenty-six patients with some degree of renal displacement were found; in a few instances the displacement was of minor degree. In 6 patients it was not certain that splenomegaly was the sole cause of the displacement. The remaining 20 cases plus 6 others collected since 1957 form the basis of the present report. The left kidney was displaced downward in 14 patients, downward and medially in 9, upward in 2, and medially in 1.

Downward displacement may be considered acquired nephroptosis and must be differentiated from renal ectopia. Nephroptosis refers to a normal kidney which has descended from its normal position. Renal ectopia refers to an abnormal renal position of congenital origin. In true ectopia there is an abnormal site of origin of the vasculature, abnormal fascial attachments, and the ureter is shortened; in nephroptosis the ureter is coiled, redundant, and elongated and the kidney can be returned to normal position. Acquired renal displacement most commonly suggests a retroperitoneal tumor.

In the present series, no indication of any specific type or cause of splenic enlargement peculiar to renal displacement was discovered. Eleven different disease entities were responsible for the splenomegaly in the 26 cases studied.

Six cases are reported.

Eleven roentgenograms; 2 tables.

RICHARD F. McCLURE, M.D.  
Redondo Beach, Calif.



**Closed Renal Injury.** L. J. Opit, K. P. McKenna, and D. E. Nairn. *Brit. J. Surg.* **48**: 240-247, November 1960. (Queen Elizabeth Hospital, Woodville, South Australia)

Seventy-seven cases of closed renal injury are reviewed. A classification of injury based on the method of presentation and duration of bleeding was used: Class 1, macroscopic bleeding evident for four days, 43 cases; Class 2, macroscopic bleeding for more than four days and evident up to ten days, 24 cases; Class 3, severe shock without bleeding or with minimal bleeding, 1 case; Class 4, persistent or recurrent bleeding beyond ten days and up to three weeks, 6 cases; Class 5, cases which presented as complications (a) anuria (2 cases) and (b) suspected acute nephritis (1 case).

One of the most controversial problems in the management of closed renal injury is the degree of diagnostic urological refinement required. Intravenous pyelography was performed during the admission period in 24 of the patients in this series, usually just before discharge.

Results were as follows:

Class of Injury	Number of patients	Findings
1	8	4 normal 2 deformity of pelvis 1 extravasation 1 non-function
2	9	4 non-function 3 extravasation 2 normal
4	5	3 non-function 1 poor function 1 deformity
5	2	1 very poor function 1 normal twenty days after admission

Retrograde pyelography was done in only 3 patients, including 1 with anuria, where catheterization was a drainage procedure.

Of 8 patients with non-function, 6 had regained pyelographic function before discharge.

Seventy-two of the 77 patients were treated without recourse to surgery. There were no deaths and no serious morbidity among these patients during their hospital stay. Five patients were explored surgically, and in 3 nephrectomy was performed. Thirty-four patients from the series were available for follow-up; all had good renal function as assessed by pyelography, although in 5 abnormalities were demonstrated.

Nine roentgenograms; 1 photograph; 4 graphs.

W. J. VARLEY, M.D.

Mercy Hospital, Pittsburgh, Penna.

**An Appraisal of Certain Tests for the Detection of Hypertension of Unilateral Renal Origin.** Samuel T. R. Revell, Jr., Francis J. Borges, George Entwisle, and John D. Young, Jr. *Ann. Int. Med.* **53**: 970-991, November 1960. (University Hospital, Baltimore 1, Md.)

Unilateral renal disease may give rise to a reversible form of severe arterial hypertension. A number of procedures have been developed for the detection of this type of unilateral hypertension, and the authors summarize their experience with such tests.

**Differential Renal Excretion of Urine and Its Sodium Concentration:** Simultaneous measurements of urine volume and its sodium concentration by means of bilat-

eral ureteral catheters were performed on 122 patients. The test was satisfactory in 67 patients and unsatisfactory in 55. This test requires meticulous attention to technical details. False-negative and false-positive results may be obtained in patients with reversible unilateral renal hypertension. Caution must be exercised in interpreting results.

**Translumbar Renal Angiography:** In 24 patients translumbar renal angiography was employed. Renal arterial circulation was considered to be normal in 10 of this number and abnormal in 10; the examination was unsatisfactory in 4 patients. In the authors' opinion, renal angiography is not an innocuous test. False-positive renal angiograms may be obtained, and demonstration of renal arterial narrowing does not necessarily indicate correctable renal hypertension.

**Tetraethylammonium Chloride Test:** The tetraethylammonium chloride test was performed on 11 patients. A pressor response was obtained in 2 of these, and a depressor response in 9. It was found that the test gave false-positive and false-negative results.

**<sup>131</sup>I-Labeled Diodrast Renograms:** Radioactive renograms were not employed to screen hypertensive patients for unilateral renal disease. The Radioisotope Laboratory of the hospital was conducting a study of <sup>131</sup>I-labeled Diodrast renograms, and 19 of the authors' patients were included in the investigation. Normal bilateral radioactive renograms were obtained in 2 of that number and abnormal renograms in 10. Abnormal unilateral renograms were recorded in 7. In the patients studied to date, no one with a normal radioactive renogram has been found to have renal hypertension. Abnormal unilateral renograms may be obtained in patients with a variety of renal lesions.

The authors conclude that there is as yet no completely reliable test to detect correctable renal hypertension and that continued investigation is necessary before the value of these tests can be accurately assessed.

The results of the 4 tests in 39 patients are summarized in a table.

Three roentgenograms; 1 drawing.

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**Urine Radiography of Excreted Iodide. A New Renal Function Test.** Burton P. Grant and Russell Wigh. *J.A.M.A.* **174**: 1304-1307, Nov. 5, 1960. (R. W., Medical College of Georgia, Augusta, Ga.)

Excretory urine radiography is a technic which measures the amount of organic iodide contained in a urine sample obtained after the intravenous injection of a contrast medium and permits accurate quantitative estimates of renal function. The authors describe the method which they have developed. The procedure simply requires comparison of radiographic film densities.

It is usually coupled with intravenous urography, using 30 c.c. of 50 per cent sodium diatrizoate (Hypaque). A sample of urine is collected in a waxed-paper cup at thirty minutes, at which time a postmicturition erect radiograph is secured. A roentgenogram is obtained of the urine sample, and the shadow of the specimen is compared with a stepladder-type aluminum wedge standard, the x-ray transmission densities of which have been calibrated in terms of the densities of known amounts of diatrizoate. Steps expressing differences of about 5 per cent in the amount of injected contrast medium have been found ample.



The accuracy of urine radiography as a measure of the contrast medium contained in the thirty-minute specimen was established by chemical analysis of excreted iodide and radioactive diatrizoate excretion values.

On the basis of their experience, the authors suggest that urine radiography values of 30 per cent or more of excreted diatrizoate in thirty minutes indicate excellent renal function; values between 20 and 30 per cent fall in the average range and 10 to 20 per cent in the reduced range; values below 10 per cent are indicative of poor renal function.

The mode of excretion of diatrizoate differs from that of other contrast media; it is excreted entirely by glomerular filtration and therefore measures this renal function purely. Comparison of the results of urine radiography with other tests of glomerular filtration, such as creatinine clearance, in general showed good correlation.

Six figures. RAYMOND W. BRUST, JR., M.D.  
Mercy Hospital, Pittsburgh, Penna.

**Correlation of Urography and Tests of Renal Function.** N. P. G. Edling, C. A. Edvall, and C. G. Helander. *Acta radiol.* 54: 433-438, December 1960. (Karolinska Sjukhuset, Stockholm, Sweden)

As a test of renal function in a series of normal patients and patients with renal disease, the authors in 1956 (*Acta radiol.* 45: 85, 1956) compared intravenous urography with inulin and PAH (para-aminohippuric acid) clearances of individual kidneys. The present article is concerned with the correlation of urographic findings with the clearance and urinary concentration tests in 20 patients with hyperparathyroidism in whom the blood calcium reverted to normal levels after parathyroidectomy.

According to the density of the renal pelves at urography, excretion of contrast medium was good in 14 patients and poor in 6. In no instance was there any perceptible difference in the roentgenographic density between the pre- and post-parathyroidectomy examinations. Of the 14 patients with good filling, 5 had normal clearances; 3 had either a reduced inulin or PAH clearance; in the remaining 6, both clearances were reduced. In 1 of the 14 patients the concentration power was not determined preoperatively. It was normal in 1 of the remaining cases and initially low in 12. After operation, the concentration power had improved in 10 and in 2 remained unchanged.

Good filling of the renal pelves in urography is therefore possible despite the fact that the results of clearance and concentration tests may be low.

Three of the 6 patients with poor contrast density at urography had moderately decreased clearances and 3 had markedly decreased clearances. The concentration power in these 6 cases was below normal, but showed some postoperative improvement in 4.

All 6 patients exhibiting poor urographic density had reduced clearances and concentration power; in 4 the concentration power improved postoperatively but not to normal values; in 2 it was unchanged. Thus, the urographic examinations, clearances, and concentration tests in this group all correspond and satisfactorily reflect reduced renal capacity. The renal capacity when the urographic density becomes noticeably poor is apparently so low that any intensification in the density produced by the urographic method is no longer able to mask the deficiency in renal function. The results of urography and renal function tests seem consistently to

correspond when urographic density is poor but are undependable in the presence of adequate density.

Three roentgenograms.

CLYDE M. WILLIAMS, M.D.  
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**Use of Chlor-Trimeton to Prevent Reactions to Hypaque in Intravenous Urography.** Owen W. Doyle. *J. Urol.* 84: 776-778, December 1960. (Duke University, Durham, N. C.)

A study was made of 800 patients to determine the value of the antihistaminic agent, Chlor-Trimeton, in preventing reactions to Hypaque in intravenous pyelography. In 600 of the group, 1 c.c. Chlor-Trimeton (chlorpheniramine maleate, 10 mg. c.c.) was added to the contrast medium. The reaction rate in the 200 unprotected patients was 17.0 per cent and in those who had received Chlor-Trimeton it was only 8.3 per cent. The incidence of nausea, vomiting, urticaria, and sneezing was significantly reduced in the antihistamine-treated patients, but vasomotor responses and pain in the arm occurred with equal frequency in both groups.

One table. JOSEPH M. WINSTON, M.D.  
University of Pennsylvania

**Four Cases of Ureteric Tumour.** Shirley Roberts. *J. Coll. Radiologists Australasia* 4: 74-76, December 1960. (The Alfred Hospital, Melbourne, Australia)

The occurrence of polypoid tumors of the ureter and bladder in association with similar lesions of the renal pelvis is a well known phenomenon. Such cases are ordinarily diagnosed at either intravenous pyelography or cystoscopy, the two examinations usually being routine in the investigation of hematuria. The occasional primary tumor of the ureter, without neoplasms of kidney or bladder, however, may well escape detection at both these procedures. Retrograde pyelography, performed with due care to show the full length of both ureters filled with contrast material, is the only means of demonstrating the non-obstructing polypoid ureteral tumor. Even when other examinations have revealed a possible cause of the hematuria, e.g., a renal calculus, bilateral retrograde pyelography is advisable to exclude an additional ureteric lesion.

Four cases of ureteric tumor are reported to illustrate the aforementioned point. In all 4 patients the presenting symptom was hematuria with or without pain. Intravenous pyelography failed to disclose the lesion in 2 patients; in the other 2, it showed definite abnormalities, but the nature and extent of the ureteric lesions were shown more effectively by retrograde pyelography. In 1 patient, the correct diagnosis was delayed for a year, the report of a normal intravenous pyelographic study probably discouraging further investigation. In another patient, retrograde pyelography showed two irregular filling defects in the ureter, considered to be due to tumor; the examination was repeated after excision of a hydronephrotic kidney and part of the ureter and revealed that the lower tumor had been left *in situ*.

Five roentgenograms. A. R. ABLA, M.D.  
Cleveland Metropolitan General Hospital

**The Delayed Nephrogram in Ureteric Obstruction.** L. M. Dugdale. *J. Coll. Radiologists Australasia* 4: 67-73, December 1960. (Dunedin Public Hospital, Dunedin, N. Z.)

A delayed nephrogram is produced when contrast

medium injected parenterally for pyelographic purposes accumulates in the renal parenchyma, later to be slowly excreted into the calyces and pelvis. In any patient in whom a kidney does not appear to excrete the contrast material as rapidly as normal, a prolonged examination is warranted. If a nephrogram is obtained, one knows that the kidney is but suppressed by a ureteric block and that later the contrast medium will enter the pelvis and ureter, in most instances disclosing the site of the lesion, although not always its nature.

The author describes the method which he employs. An intravenous pyelographic examination is continued up to twenty-four hours in patients in whom no excretion or only minimal excretion of contrast medium by the kidneys is demonstrable on three- and fifteen-minute roentgenograms. Occasionally a second injection is given about one hour after the first to reinforce the contrast obtained. Once the nephrogram has appeared, further roentgenograms will show the slow passage of the medium into the calyces, pelvis, and ureter to produce a pyelogram, although a wait of several hours may be required before sufficient contrast is reached to disclose the site of obstruction. Roentgenograms taken with the patient prone and after he has been erect for a few minutes are often helpful, as the relatively dense contrast medium tends to sink through the urine into the dependent portions of the pelvis and ureter.

The salient features of 9 cases in which delayed pyelography proved of value are summarized in a table.

Twelve roentgenograms. A. R. ABLA, M.D.  
Cleveland Metropolitan General Hospital

**Periureteral Fibrosis.** Homer L. Twigg, Jr. *Am. J. Roentgenol.* **84**: 876-885, November 1960. (Georgetown University Medical Center, Washington 7, D.C.)

The entity known as periureteral fibrosis is characterized by a retroperitoneal inflammatory mass having a definite histologic picture and producing a progressive obstruction of the upper urinary tract.

The etiology is unknown, but in all probability the process may be looked upon as an exaggerated local response to many different stimuli, be they infection, trauma, or tumor.

The author reviews the findings in 36 well documented cases from the literature and reports 4 more. Of the 40 patients, 31 were males and 9 females. The average age for the entire group was 43.7 years. Thirty-six patients were Caucasian and 4 Negro. Symptoms, although quite varied, were most often related to the gastrointestinal tract. The paucity of urinary symptoms was remarkable. Physical examination rarely helped to establish the diagnosis. Most of the 23 cases in which the urinalysis was reported showed either red blood cells or white blood cells. The blood urea nitrogen was elevated, and the hemoglobin and hematocrit were decreased. Anuria was present at some stage in the course of the disease in 14 of the 40 patients. Intravenous pyelography was performed in 24 patients, and in 11 of these findings were normal two weeks to six months prior to diagnosis. Nine had bilateral involvement, consisting of obstruction, hydronephrosis, or failure of excretion of the contrast medium. Retrograde pyelography was done in 31 patients: 17 of the pyelograms showed bilateral involvement, 8 left-sided involvement, and 6 right-sided involvement. A consistent pyelographic finding was hydronephrosis with a hydroureter in the upper third, tapering gradually to a smooth cone-like narrowing in the midureter at the point of the segmental constric-

tion. Another clue to the diagnosis was the sudden loss of function of a kidney that was previously known to show a normal excretion. The normal fat lines about the retroperitoneal structures, particularly the psoas border, may be obliterated.

At operation, the process is seen as a dense fibrous plaque which may involve only a small segment of the ureter or may extend all the way from the kidneys to the sacrum. The area between the bifurcation of the aorta and the brim of the pelvis is most commonly affected. Microscopically, the mass is composed of dense fibrous connective tissue with scattered foci of chronic inflammatory cells, predominantly lymphocytes. It has the general nature of a scar or keloid.

The principles of treatment of periureteral fibrosis are to relieve the obstruction by providing adequate drainage and to preserve renal tissue. Ureterolysis, nephrostomy, or even localized ureteral resection and plastic repair may be employed. Roentgen therapy was given in 5 cases; it is of limited value, if any.

The prognosis is good with proper therapy but, because the condition may exist long before the diagnosis is made, irreversible damage to the kidneys may occur, leading to fatal complications in 15 per cent of the patients.

Ten roentgenograms; 1 photomicrograph; 7 tables.  
RICHARD F. McCURE, M.D.  
Redondo Beach, Calif.

**The Urethrovessical Angle and Stress Incontinence.** W. A. W. Dutton. *Canad. M. A. J.* **83**: 1242-1245, Dec. 10, 1960. (McGregor Clinic, Hamilton, Ont., Canada)

One hundred and forty-six patients were critically evaluated as to demonstrable urinary stress incontinence. Sixty-three were continent and 83 were not. Lateral cystourethrograms of all were obtained when at rest and when straining. In 22 patients an additional lateral view was obtained with the patient supine.

The first analysis showed a marked correlation between the absence of the posterior urethrovessical angle and stress incontinence (91.5 per cent) but only a moderate correlation between the presence of the angle and the urinary incontinence (66.7 per cent). In 47 per cent of the cases there was difficulty in measuring the urethrovessical angle because of "short posterior angle," "beaking," "paradoxical behavior of the angle," and "bladder deformity." A second analysis, excluding these doubtful cases, showed good correlation between the absence of the posterior urethrovessical angle and incontinence (90.0 per cent) and also good correlation between the presence of the angle and continence (89.2 per cent). The relative lack of correlation between the appearance of the urethrovessical angle and uterine or vaginal prolapse is mentioned. Additional evidence is advanced to support the theory that the angle is normally maintained by the intrinsic muscular arrangement at the bladder neck but can be produced by vaginal or suprapubic surgery. In a follow-up series of 13 cases, it was suggested that urethroplasty sometimes fails to cure stress incontinence partly because the urethrovessical angle is not restored.

In 5 (16 per cent) of 39 cases in which the straining films were repeated, a serious error would have been introduced had the measurement of the angle from the first exposure been accepted.

The posterior urethrovessical angle may not be the fundamental factor concerned with urinary control but

it is probably closely linked to such a factor or factors, and, until the physiology of continence and pathology of incontinence are better understood, it would seem worthwhile to continue attempts to restore the angle in incontinent patients and to explore better means of doing so.

Three roentgenograms; 2 tables.

**Renal Angiography in Hypertensive Disease.** M. B. M. Denny and A. J. Tinker. *South African M. J.* **34**: 852-854, Oct. 1, 1960. (Johannesburg, Union of South Africa)

In the last decade aortography has become an increasingly popular method of investigation in cases of hypertension. In the pyelonephritic contracted kidney, however, any attempt to detect abnormality in the interlobular and arcuate vessels by this method is fruitless. Efforts must be confined to the larger renal vessels, with the exception of the negative defect in the nephrographic phase associated with a localized renal infarction. A normal pyelogram is no contraindication to aortography as it may be obtained in the Goldblatt kidney if the occlusion is not complete.

The authors consider translumbar aortography with its attendant dangers to be outmoded and redundant. They describe in detail their technic with 76 per cent Urografin and a No. 205 polythene catheter. The necessity of a small second aperture in the catheter, 1 cm. proximal to its tip, is emphasized. This opening is angled toward the aortic wall and is on the superior and convex aspect of the catheter. Its purpose is to ensure filling of the aorta at the point of origin of the renal artery, a matter of importance if by chance the tip of the catheter enters the renal artery; when a narrowed renal artery origin might otherwise be missed in the absence of associated opacification of the adjacent aortic blood flow. Reducing the blood pressure by medical means will ensure better filling of the renal artery. The authors now use a 9-inch image-intensifier and 35-mm. camera and believe that with some refinement of technic with respect to film speed, type, and development, the whole nephrographic procedure may possibly be satisfactorily achieved on cine film.

Six roentgenograms.

**Dynamic Urethrography: A Cineradiographic Method.** George M. Fister, Russell L. Nichols, C. V. Zabriskie, and John F. Stucki. *J. Urol.* **84**: 733-737, December 1960. (704 Eccles Bldg., Ogden, Utah)

The authors describe a simplified method of retrograde and voiding urethrocytography, which under average conditions permits completion of the examination in fifteen to twenty minutes. Premedication usually consists of 50 to 75 mg. Demerol shortly before the examination is begun. After routine preparation of the glands a 16 to 20 F Foley catheter is introduced. The bag of the catheter is passed as far as the fossa navicularis and then inflated with 1 to 2 c.c. of water. Steripaque (a micropaque barium suspension of 0.1 to 0.5 microns) has been found to give better contrast than aqueous solutions of sodium iodide. The contrast medium and carbon dioxide are delivered alternately under manometric control, with a pressure of 60 to 100 mm. Hg. With the patient in the left supine oblique position, cineradiographs are taken while the medium enters the urethra and during the first part of the introduction of carbon dioxide. One or more standard views may be obtained, with the filming fluoroscope. Carbon

dioxide is introduced until the patient feels a desire to void. The catheter is then removed, and the table brought into an upright position. The act of voiding is recorded with the cineradiographic apparatus, at 15 or 30 frames per second.

A series of cases, with normal micturition, diminished urinary stream, postmicturition dribbling, recurrent urethritis, and bleeding, have been studied by the above method. Films used for analysis of motion of structures at the floor of the bladder were made in postero-anterior projection. The successive positions of the urethral orifice during the act of micturition are shown in drawings. During the initial phases of urination the orifice moves downward by an amount corresponding approximately to the downward movement of the position of the external sphincter. At the same time the urethral orifice moves slightly medialward. It is hypothesized that this motion of the urethral orifice elongates the intramural portion of the terminal ureter, thus preventing urethral reflux during urination. The entire floor of the bladder, the prostatic urethra, and the external sphincter descend approximately 1.5 cm. during initiation of urination.

The essential actions of voluntary interruption of the urinary stream occur very rapidly. Contraction of the external sphincter initiates the act, followed immediately by contraction of the prostatic portion of the urethra and in turn by contraction of the internal sphincter. The three events take place within 4 frames of the cine-strip, i.e., in just over 0.25 second.

During micturition in the patient with benign prostatic hypertrophy, the floor of the bladder descends in the usual fashion, but the normal funnel shape of the zone of the internal sphincter fails to develop.

The anatomic extent of strictures and urethral diverticula have been readily demonstrated by the method described. MILTON A. FRIEDLANDER, M.D., University of Pennsylvania.

**Urethrographic Studies of Prostatic Tuberculosis.** Niels Bentzen. Copenhagen, 1960. (Finsen Institute, Copenhagen)

In this monograph the author reports urethrographic studies carried out at the Finsen Institute, Copenhagen, and at Kysthospitalet, Refsnaes, in the three-year period between 1954 and 1957, on a group of males previously investigated for tubercle bacilluria.

The urethrographic technic employed is described. Complications were generally minor. Urethrocavernous reflux was seen in 4 per cent of cases, usually accompanied by bleeding from the anterior urethra due to the rupture which caused the reflux. One case of tuberculous epididymitis arose, and, while a causal relationship to urethrography could not be ruled out entirely, the possibility of chance coincidence was considered not unlikely. The genetic radiation hazard was slight, since the majority of patients were over forty years of age.

Abnormal filling of the prostate occurred in 126 of 155 patients with bacilluria. The changes were of three grades: (1) filling of one or more glandular ducts, 27 cases; (2) filling of one or more cavities, 92 cases; (3) total destruction of the prostate, 7 cases. Normally the contrast material does not flow into the prostatic ducts and tissue; however, duct filling and cavitation are not specific for tuberculosis and will be seen in non-specific infection and prostatic hypertrophy. Final interpretation of the urethrographic findings must be based on the total clinical picture.

When all abnormal findings are taken into account, the prostate was involved in 92 per cent of the 155 cases. Combined renal and genital tuberculosis was present in 80 per cent. Isolated renal tuberculosis was rare, occurring in only 7 cases (4.5 per cent), as was isolated genital tuberculosis (14 per cent) and tubercle bacilluria without other findings (1.3 per cent). Comparison of the x-ray changes in the prostate and kidney showed that severe renal involvement need not co-exist with prostatic disease of equal degree, the number of severe renal lesions being of the same percentage in the mild and severe degrees of prostatic tuberculosis.

Chemotherapy was beneficial even despite severe prostatic lesions. In 90 per cent of 126 cases it was followed by clearing of the tubercle bacilluria. The cure rate has been reported the same for men and women. In the light of the urethrographic investigations, this must be interpreted as a sign that chemotherapy exerts a favorable effect upon the prostatic as well as the renal tuberculosis. In some cases, x-ray examination showed an increase in size of prostatic cavities, and the appearance of new cavities as the bacilluria improved. Thus urethrographic appearances do not return to normal, but the persisting, smooth-walled cavities must be interpreted as healed lesions; presumably epithelization takes place.

Of considerable interest to the author is the pathogenesis of genitourinary tuberculosis in the male. The prevailing explanation is that tuberculosis of the prostate and epididymis is due to canalicular infection secondary to renal tuberculosis. It would seem, however, that most probably the lesions represent multiple hematogenous foci, the kidney and male genital system having an equal predisposition to destructive changes. Although present, the canalicular communication is presumably of less pathological significance than might be imagined *a priori*. Several facts support this view: (1) In the female the combination of renal and genital tuberculosis is much more uncommon, although canalicular communication exists also. (2) Cavernous prostatic tuberculosis does not occur with preference in the most severe renal cases. (3) Prostatic tuberculosis and tuberculous epididymitis differ from the superficial mucosal lesions in the bladder, which are canalicular

and often heal or improve after nephrectomy. Genital tuberculosis is destructive and fairly refractory to nephrectomy, behaving as a more independent entity. (4) It is known that several tuberculous foci may occur in an organ system without canalicular communication, as in the adrenals, in which involvement is more often bilateral than unilateral.

Forty-five roentgenograms; 15 tables; 3 charts.

CHARLES M. GREENWALD, M.D.  
Parma, Ohio

## TECHNIC

**Requisites for Good X-Ray Cinematography.** Guy Duckett. J. Canad. A. Radiologists 11: 81-83, December 1960. (Jean Talon Hospital, Montreal, Que., Canada)

It is not possible to do amateur cineradiology; no corners can be cut. Only good work is acceptable. If the principles of cinematography are not absolutely respected, the results will be poor and higher radiation exposures than necessary will result. Cineradiology is often said to be a strictly functional approach to problems; individual frames cannot be studied with the hope of finding detail. This is partly false. When good cinematography is achieved, it has good definition, and if radiologists are ready to use as much energy in the technicalities of this new discipline as they do with their conventional work they will be rewarded with gratifying results.

There have been many discussions as to what type of equipment will give good results for roentgen cinematography. The author believes that the problem lies much deeper than in the resolving power of 16-, 35-, or 70-mm. films, and observation of the results achieved by different workers suggests that it is not the type of equipment, the size of the camera, and the resolving power of the film that count, but the perfection to which the technic has been evolved with the equipment used.

Requirements of x-ray cinematography considered in detail are the x-ray factors, the image intensifier, the lenses, the camera, film selection, processing, and resolution tests.

One 16-mm. cine strip.

## RADIOTHERAPY

**Lymphosarcoma: The Effects of Therapy and Survival in 1,269 Patients in a Review of 30 Years' Experience.** Saul A. Rosenberg, Henry D. Diamond, and Lloyd F. Craver. Ann. Int. Med. 53: 877-897, November 1960. (Peter Bent Brigham Hospital, Boston 15, Mass.)

This report from the Memorial Center for Cancer and Allied Diseases (New York) summarizes information on 1,269 cases of lymphosarcoma in respect to age and sex distribution, the histologic classification, transition to leukemia, the results and complications of therapy, and the prognosis and survival of various subgroups. The general term, lymphosarcoma, is used to include all primary malignant tumors of lymphoid origin (except Hodgkin's disease). Three types are recognized: giant-follicle lymphosarcoma (162 cases); reticulum-cell sarcoma (554 cases); small-cell lymphosarcoma (553 cases).

The age range, at the time of the probable clinical onset of the disease, extends from twenty-two months

to ninety-two years. The greatest number of cases occur during the fifth decade of life. The median range for the entire group was 49.7 years. Males were more frequently affected than females, in all age groups.

The value of radiation therapy in the treatment of patients with lymphosarcoma is well established but, though the comparative radiosensitivity of these tumors generally permits some degree of symptomatic improvement, it is not known whether this treatment has significantly prolonged survival.

The first course of radiation therapy resulted in objective improvement in 78.4 per cent of the 1,102 patients treated; in over 20 per cent the benefit was classified as complete. The second course of therapy gave almost equal results. In most cases, the usefulness of radiation therapy was eventually limited by the generalized spread of the disease, by increased radioresistance of the tumor, and by diminished tolerance of the patient.

Radioactive phosphorus in the treatment of lym-



phosarcoma initially received enthusiastic support, but it is now generally restricted to those patients showing the transition to chronic lymphocytic leukemia. Among 71 patients treated with radioactive phosphorus, 14.1 per cent exhibited objective improvement. Irreversible bone-marrow depression or aplasia developed in 11 patients (15.5 per cent).

Surgical procedures were usually attempted for only very early, well localized disease. Nineteen patients underwent radical neck dissections; 6 of this group have survived for long periods without evidence of disease. Three of these patients received radiation to the surgically treated area postoperatively. In 4 of the 6 patients disease recurred in other sites from seven to twenty-four months after surgery. In 3 cases radiation therapy has controlled the disease for periods of from five to twenty-five years. The fourth patient underwent a partial radical neck dissection on the opposite side also, with postoperative irradiation, and is now well, more than fifteen years later.

Three hundred and twenty-six patients had one course of alkylating agents, usually nitrogen mustard or triethylene melamine, and 157 had two courses. Objective benefit, not attributable to simultaneously administered radiation, was observed in 19.3 per cent of patients after the first course of treatment and in 10.8 per cent after the second. In only 2 instances did this improvement meet the criteria of complete benefit. Irreversible bone-marrow damage occurred in 3.1 per cent of those who were given these drugs. Severe uric acid nephropathy developed in 2 patients receiving nitrogen mustard; in 1 it proved fatal.

Severe complications occurred in 21 of the 1,102 patients (1.9 per cent) who received radiation therapy. These were radiation osteitis, persistent and severe radiation pneumonitis and fibrosis, severe skin ulcerations requiring plastic surgical repairs, severe iritis and glaucoma, and aggravation of tracheal and superior vena caval obstruction.

Lymphosarcoma is more rapidly fatal in children than in adults. Though 17.4 per cent of the children do survive five years or more, when the disease takes a downhill course it does so at an accelerated rate.

Giant-follicular lymphosarcoma is much more benign than the other two types of lymphosarcoma. Patients with small-cell lymphosarcoma survive slightly but significantly longer than those with reticulum-cell sarcoma.

The authors conclude that radiation therapy remains the treatment of choice for lymphosarcoma, and that no increase in survival can be demonstrated over a period of twenty-five years, despite the addition of antibiotics, steroids, and alkylating agents to the therapeutic program.

Ten figures; 1 table. STEPHEN N. TAGER, M.D.  
Evansville, Ind.

**Post-Operative Supravoltage Radiotherapy in Carcinoma of the Breast.** E. Holden. J. Coll. Radiologists Australasia 4: 96-100, December 1960. (Peter MacCallum Clinic, Launceston, Tasmania, Australia)

The author presents the method of postoperative radiotherapy employed in cancer of the breast at the Peter MacCallum Clinic (Launceston, Tasmania). The principles indicating the areas to receive postoperative radiotherapy are listed. The apparatus used is a cobalt Theratron Junior. The maximum size of field in any one direction is 15 cm.

**Axilla:** The dosage delivered is 4,500 rads at 4 cm. depth, which necessitates 5,625 rads peak dose in four weeks. The width of the field is always 8 cm. to allow for penumbra, and the length of the field varies between 15 and 12 cm.

**Chest Wall:** Glancing tangential fields are used, always 15 cm. long and 10 cm. wide. The medial field is placed 2 cm. lateral to the midline on the opposite side. The lateral field is placed posterior to the axillary stab drain (if present); otherwise, a separation of 16 cm. is selected, provided the lateral field is far enough back to cover all potentially residual tumor. A dose of 5,000 rad is given over the chest wall in four weeks. In some cases where field separation is wide, only 4,500 rads can be given. Dosage to the internal mammary chain is raised to 4,500 rads when this is reasonable.

There are no immediate sequelae from this course of treatment. Forty-one cases have been treated, 20 with both chest wall and axillary apex techniques.

The author is satisfied that the technics described can be employed with accuracy and are without discomfort to the patient. He believes that, with effective methods of supravoltage radiotherapy giving adequate dosage without sequelae, surgery as a line of attack in breast cancer may become obsolete.

Four figures; 1 table. S. ASMAR, M.D.  
Cleveland Metropolitan General Hospital

**Cancer of the Middle Ear and Mastoid.** Henning Sørensen. Acta radiol. 54: 460-468, December 1960. (Aarhus Kommunehospital, Denmark)

During the period 1939-53, 12 patients (6 men and 6 women) were admitted to the Radium Centre and the University Ear Clinic (Aarhus Kommunehospital, Denmark) with a diagnosis of cancer of the middle ear and/or mastoid. Their ages ranged from forty-four to seventy-five years. In 10 the cancer developed during the course of chronic otitis media; only 2 had not previously suffered from aural discharge. In 7 the discharge was blood-stained. The frequent occurrence of chronic otitis media in these cases suggests that long-standing suppuration is of etiologic significance and underlines the importance of careful observation of patients with this condition, especially if granulation tissue or polyps are present. Bleeding from the ear is presumably the most significant symptom; it may occur early in cancer and is relatively rare in chronic otitis media. Pain is another characteristic symptom.

All the patients were treated with a combination of radiotherapy and surgery. Roentgen therapy was given preoperatively in some cases and after surgery in others. Heyman radium capsules were inserted into the cavity immediately following removal of the tumor in 4 patients. Calculated x-ray, gamma-ray, or combined roentgen- and gamma-ray doses ranged from 832 to 8,400 r. The treatment time is not given, and the author cannot correlate tumor dose with long-term results.

Surgery is performed under general anesthesia. When the mastoid process has been resected and access to the middle ear is free after removal of the bridge, the cavity is inspected under the microscope. Tissue suspected of malignancy is submitted to histologic examination, and radical dissection of all tumor tissue is made under microscopic control.

There were no immediate postoperative deaths. Six patients died from cancer from two to twenty-two months after the operation. In all there were survivors.

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signs of intracranial tumor invasion as paralysis of the soft palate or the hypoglossal nerve, meningitis, or ataxia. One patient died two and a half years after surgery from cardiac disease without signs of tumor recurrence. The remaining 5 survived for more than five years without recurrence. It is worthy of note that recurrence of the neoplasm was not seen in any case after the first eighteen to twenty-four months.

Radiotherapy alone requires a high dose level which may damage the brain stem or cause bone necrosis necessitating subsequent surgical treatment. It does not seem to be superior, in the author's opinion, to radical operation combined with radiotherapy.

Three tables. PAUL H. MOORE, M.D.  
University of Florida, Gainesville, Fla.

**Carcinoma of the Larynx: Comparative Experience in the Management of 951 Limited Lesions.** Brian F. McCabe and John E. Magielski. *Ann. Otol., Rhin. & Laryng.* 69: 1013-1019, December 1960. (University Medical Center, Ann Arbor, Mich.)

In the authors' opinion, a small, localized squamous-cell carcinoma on the edge of a vocal cord is more amenable to cure than any other cancer except a basal-cell carcinoma of the skin. This is of course largely by virtue of early symptomatology, ease of visualization, and the paucity of lymphatics in the vicinity of the true cords. The authors' experiences and those of 12 other laryngologists and radiotherapists with 951 limited lesions (tumor limited to true cord, reaching neither the anterior commissure nor the vocal process, and not impairing cord mobility) are tabulated. The average five-year cure rate for 668 patients with limited laryngeal cancers treated by surgery was 83 per cent and for 283 managed by radiotherapy it was 75 per cent.

The authors stress that a good serviceable voice cannot be guaranteed, even upon control of the tumor, whether the patient is treated by limited surgical procedures or by primary radiotherapy.

In an occasional patient for whom either hemilaryngectomy or irradiation may constitute over-treatment, the procedure carried out has been limited to direct laryngoscopy and cord scalping, or repeated cord scalping, and close observation. This treatment has been instrumental in producing a 100 per cent cure rate in a selected group of patients. The type of lesion amenable to this form of therapy has constituted roughly 10 per cent of all limited cases.

The authors conclude that in the small glottic carcinoma both surgery and x-ray therapy offer excellent results and today the latter is the preferred form of therapy if this is administered by a competent radiotherapist who observes the larynx daily. This of course does not apply in those communities where the general radiologist with limited radiation facilities manages the occasional therapy case. [May not the same comments be made for the surgical approach?—J.W.B.] If during radiotherapy it becomes evident that the tumor is not being controlled, surgery should be instituted.

Two tables. JAMES W. BARBER, M.D.  
Cheyenne, Wyo.

**Solitary Plasmacytoma of Petrous Bone. Report of a Case with Neurologic and Radiographic Remission Following Roentgen-Ray Therapy.** Richard L. Rovit and Charles A. Fager. *J. Neurosurg.* 17: 929-933, September 1960. (C. A. F., Lahey Clinic, Boston)

Multiple myeloma involving the vertebral column

frequently produces neurologic symptoms secondary to compression of the spinal cord and spinal nerve roots. Similar neurologic manifestations of intracranial involvement, however, are extremely rare. In an exhaustive review of the world literature, Clarke (*Brain* 77: 61, 1954) found only 24 cases of multiple myeloma involving the base of the skull and producing cranial-nerve palsies. He recorded an additional case. Ten of these 25 cases were presented as examples of solitary plasmacytoma of the base of the skull.

The authors report the case of a 55-year-old woman with a solitary plasmacytoma of the petrous bone in whom involvement of the brain stem, cerebellum, and cranial nerves produced severe and incapacitating signs and symptoms. Roentgen examination of the skull revealed extensive destruction at the base on the left side. Subtotal resection of the neoplasm was carried out, followed by roentgen therapy (3,000 r tumor dose; time not specified) directed to the base of the skull. Within a short time striking neurologic improvement was observed which had been maintained at the time of the report for two years. In addition, definite recalcification and formation of new bone was apparent in the areas previously completely eroded by the expanding neoplasm.

Seven years after the onset of symptoms, roentgen examination and studies of urine, blood, and bone marrow disclosed no signs of recurrence or dissemination of the disease beyond the base of the skull.

One photomicrograph.

DON E. MATTHIESEN, M.D.  
Phoenix, Ariz.

**Clinical Aspects, Therapy, and Prognosis of Malignant Testicular Tumors and Their Recurrences.** Fritz Masch. *Strahlentherapie* 113: 217-241, October 1960. (In German) (Allgemeine Krankenhaus St. Georg, Hamburg, Germany)

After a brief review of the literature on malignant tumors of the testicle, the author stresses the fact that these tumors are relatively rare and that almost 96 per cent of them are malignant. It is understandable that the lymphatic drainage of the testicles is of greatest interest to the examiner, as malignant testicular tumors metastasize almost exclusively via the lymphatics. Chorioepitheliomas, however, spread predominantly through the blood stream, necessitating detailed knowledge of the circulatory system of the testicles.

Testicular tumors are more frequently encountered on the right side than on the left, which possibly can be explained by the fact that the right testis usually descends later than the left and by the known tendency toward tumor formation in an undescended testis. Bilateral testicular tumors are rather uncommon. Gynecomastia is seldom observed in the majority of testicular tumors, especially the seminomas, but is frequently found in chorioepithelioma with a positive Aschheim-Zondek reaction.

In view of the pathways of metastasis of testicular tumors, the author recommends radiation therapy ten to twelve days after surgery as follows:

Each of the superior and two inferior abdominal portals (10-15 cm.), and of the corresponding posterior fields, receives a skin dose of 300 r  $\times$  5 within five to six weeks. After a treatment-free interval of three months, the radiation series is repeated. In this way, the para-vertebral retroperitoneal area receives a depth dose of 2,500 to 3,000 r, which is considered adequate as a pro-

phylactic treatment in patients without manifest metastasis.

In patients with proved metastasis in the lymphatic drainage, however, a full tumor dose of 5,000 to 6,000 r to the retroperitoneal area should be attempted.

In all these patients the scrotum is carefully protected by a lead capsule of 2 mm. thickness. In the presence of solitary distant metastasis, as in the lungs or mediastinum, localized radiation therapy with 2,500 to 6,000 r within three to seven weeks is administered.

Because of the high radiosensitivity of the majority of testicular tumors, especially seminoma, the author stresses the importance of routine postoperative radiation therapy along the entire lymphatic drainage of the vena spermatica.

This report is based on 114 malignant testicular tumors observed for at least five years, with a detailed listing of the therapeutic results.

Nine roentgenograms; 3 photographs; 5 graphs; 7 tables.

HERBERT C. POLLACK, M.D.  
Chicago, Ill.

**Peyronie's Disease.** M. G. Varadarajan. *Mediascope*, December 1960. (Madras Medical College, Madras, India)

The etiology, pathology, symptoms, diagnosis, and treatment of Peyronie's disease are discussed. The combination of radium plaque with tocopherols has been the most effective method of management, with 84 per cent of the cases cured or markedly improved. Radium is not ideal, but it is logical, safe, and promises better results than any other treatment reported to date. The patients must be followed for at least two years before the final result is determined, and they must be warned of possible burns and even superficial scarring of the skin. There is no fear of sterility and loss of libido if the treatment is carried out with proper precautions.

A case is reported, unique in the absence of symptoms but with roentgen demonstration of calcification. The patient was a diabetic and trauma to the sheath of the corpora cavernosa might have initiated the process of a chronic fibrous tissue reaction which later underwent a progressive calcification.

One roentgenogram.

**Integral Dose and High Energy Radiation.** Giorgio Scarpa. *Brit. J. Radiol.* 33: 770-775, December 1960. (Istituto di Radiologia dell'Università di Roma, Italy)

It is well known that one of the main advantages of high-energy radiation therapy is the marked improvement in the general tolerance of the patient. The reason for this improvement may be the reduction in the total energy absorbed (the integral dose) for the same tumor dose, as the energy is increased. In order to investigate the magnitude of this effect, integral doses have been calculated for a variety of treatment conditions.

The integral dose delivered by a beam of radiation may be conveniently divided into two parts, inside and outside the geometrical edge of the beam. The integral dose delivered inside the beam rises markedly for the same skin dose with increasing radiation energy. Outside the beam edge the reduction of lateral scatter as the energy of radiation increases results in a decrease of the integral dose in this region. The sum of these two components, the total integral dose, changes only slowly

with radiation energy. The percentage depth doses will, however, rise with increasing energy and it would therefore be expected that the relative integral dose (ratio of integral dose to tumor dose) would decrease as the energy of the radiation becomes greater. Tables are given covering tumor depths from 1 to 20 cm., patient thickness of 10, 20, and 30 cm., and x-rays of h.v.l. 0.5 and 2 mm. Cu, cobalt 60, and 15 Mev electrons and x-rays, for field sizes  $4 \times 5$  cm.,  $10 \times 10$  cm., and  $20 \times 20$  cm.

From the point of achieving a minimum integral dose relative to the tumor dose, it would appear that for deep-seated tumors the optimum energy of x- or gamma-rays is near to that of cobalt-60 gamma rays. For more superficial lesions, 15-Mev electron beams are superior in this respect to any of the x- or gamma-ray energies considered.

Four figures; 6 tables.

LUCILLE DU SAULT  
The Henry Ford Hospital

**The Potentiation of Radiation Effects with 5-Fluorouracil.** Laurance V. Foye, Jr., Forrest M. Willett, Byron Hall, and Merall Roth. *California Med.* 93: 288-290, November 1960. (VA Hospital, San Francisco 21, Calif.)

In the evaluation of a possible synergism of 5-fluorouracil and orthovoltage roentgen therapy, 25 patients with inoperable malignant disease were subjected to a combination of subtoxic doses of the drug (total dose approximately 90 mg. per kilogram of body weight, by intermittent intravenous slow-drip administration) and an x-ray tumor dose limited to 2,000 r. The radiation was administered at 250 kilovolts (h.v.l. 3 mm. Cu) in daily tumor doses of 100 to 200 r, five days a week. The usual course of combined therapy required two weeks. Patients were selected by the following criteria: (1) The disease must be biopsy-proved, inoperable, and measurable objectively. (2) The tumor must be of a type known to respond poorly to standard radiation therapy. (3) The patient must be willing to accept experimental therapy and must be likely to survive the four to six weeks needed for treatment and evaluation.

Toxicity occurred in half the patients, manifested by pharyngitis, esophagitis, proctitis, leukopenia, and thrombocytopenia. In each instance of inflammation, the area involved was within the field of radiation.

Combined therapy produced a greater degree and higher incidence of tumor regression than has been reported with either mode of therapy alone. The total effect is more than that expected on the basis of adding together the separate responses obtainable by either type of treatment. Thus, a true antitumor synergism appears to exist in this form of combined therapy. Of 8 patients with epidermoid carcinoma of the lung, all showed rapid and significant regression of the lesions under the combined therapy and several were in good health without evidence of tumor six months after treatment. Similar responses were observed in single cases of epidermoid carcinoma of the larynx, adenocarcinoma of the rectum, mucinous adenocarcinoma of the stomach, and embryonal-cell carcinoma of the testis. One patient each with epidermoid carcinoma of the larynx, epidermoid carcinoma of the esophagus, and adenocarcinoma of the rectum showed no objective improvement. The remaining 10 patients had either a moderately favorable response (slight tumor regression and symptomatic improvement) or could not be evaluated with respect to tumor response. The patient

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with embryonal-cell carcinoma of the testis had 2 metastatic lesions in the lungs. Chest films showed no response of the lesions to 5-fluoro-uracil alone, slight regression following treatment with 2,000 r alone, and complete disappearance of the metastasis with the combined therapy.

In an Addendum, one of the authors (B. H.) reports similar results in a subsequent series of 75 patients given the combined therapy.

Three roentgenograms; 1 chart; 1 table.

JOHN F. RIESSER, M.D.  
Springfield, Ohio

## RADIOISOTOPES

**Medical Radioisotope Scanning.** Henry N. Wagner, Jr., John G. McAfee, and James M. Mozley. *J.A.M.A.* 174: 162-165, Sept. 10, 1960. (The Johns Hopkins Hospital, Baltimore 5, Md.)

Radioisotope scanning, the visualization of an internal organ by determining the spatial distribution of a radioisotope within the body, has made rapid progress in the last few years. Advances have been chiefly along three lines: (1) the development of improved radiation detection equipment; (2) the production of radiopharmaceutical compounds that concentrate in organs, e.g., colloidal gold in the liver and chlormerodrin (Neohydron) in the kidneys; and (3) a more complete understanding of the factors necessary to obtain scanning images that are readily interpretable by the clinician. The material and radionuclide employed for the various scanning procedures are given in a table.

The detector used at the Johns Hopkins Hospital consists of a shielded  $3 \times 3$ -inch sodium iodide crystal, photomultiplier tube, and focusing collimator. Following the injection of the radioactive material, two motors move the probe back and forth automatically over the area of the patient's body being studied. The primary radiation coming from the radionuclide immediately beneath the probe is detected, amplified, and recorded automatically. A roentgenogram of the area under investigation is made while the patient is lying on the scanning table. The scanning image is then superimposed on the roentgenogram by means of localizing markers.

The scanning procedure has been successfully employed in clinical problems relating to the thyroid gland, liver, kidney, spleen, and heart. Further technical refinements may be expected within the next few years which will make it an even more useful tool in medical diagnosis.

Seven roentgenograms and scanograms; 1 drawing.

WILLIAM MARTEL, M.D.  
University of Michigan

**The Radioisotopograph in Liver Diseases.** P. Ollino, G. Farinet, and D. Fiandesio. *Minerva fisioterap.* 4: 221-231, September-October 1959. Abridged English translation in *Panminerva med.* 2: 542-549, November 1960. (Università di Torino, Italy)

At the authors' Nuclear Medicine Department, an isotopograph is made and superimposed on a roentgenogram to make what they call a radioisotopograph. The isotopographic agent is  $\text{Au}^{198}$  in studies of the liver. Examinations were made in patients in whom a correct diagnosis had already been made or in those in whom the results were later confirmed at surgery.

Pathologic changes of the liver detected by this technique may in theory be classified as (a) those caused by displacement of the organ or modifications of its relationships; (b) those of increase or decrease in size, either of the whole organ or in part, in association with fairly conspicuous deformation; (c) those of morphol-

ogy, roughly classified as dense images or lacunae, often accompanied by modifications of topography and volume; (d) those of parenchymatous structure revealed by modified fixations of the radioactive substance.

In practice several of these changes may be seen in the same case, with tracings of complicated interpretation. Dimensional alterations of the liver are accompanied in the majority of cases by changes of the stromatic component and of the parenchymatous cells. Cysts, tumors, and abscesses, if small and deeply situated, may cause lacunae with a fairly clear outline; if superficial or considerably developed, they result in changes in shape and size. Large cysts may also cause displacement of the organ, clearly seen on the radioisotopograph. Diffuse metastatic neoplasms can simulate dimensional changes which do not exist. Deeply situated, small intrinsic changes may be masked by the parenchyma which normally takes up the radioactive substance; superficial cystic formations may escape detection if they do not deeply affect the liver parenchyma.

In spite of these limitations, the authors believe that the radioisotopographic technique, if correctly carried out and with care to check the results, may make a considerable contribution to the study of hepatic disease, especially when it is regarded as a complementary study to other clinical and laboratory investigations.

Eight isotopographs; 8 radioisotopographs; 1 arteriogram.

**A Ten-Minute Test of Thyroid Function.** H. P. Higgins. *Canad. M. A. J.* 83: 1234-1239, Dec. 10, 1960. (Department of Medicine, University of Toronto, Toronto, Ont., Canada)

A radioactive-iodine test of thyroid function has been in use at St. Michael's Hospital, Toronto, since 1957, that takes only ten minutes of the patient's time. (*J. Clin. Endocrinol.* 19: 557, 1959. *Abst. in Radiology* 74: 522, 1960). The author has compared it with the clinical state of the patient and with other tests of thyroid function in 576 cases. The patients were divided into groups according to their clinical diagnosis, based on history, physical examination, clinical course, and, in doubtful cases, the response to treatment.

In 116 out of 133 cases of thyrotoxicosis, the ten-minute value was elevated more than the twenty-four-hour uptake value. In only 13 instances was the reverse situation true. In 53 of 76 cases of hyperthyroidism, the ten-minute uptake gave a better spread above normal than the P. B. I., while the P. B. I. gave the better spread in 21. In Graves' disease the ten-minute uptake was better in 39 of 49 cases, but in toxic nodular goiter the two tests were of equal value. No patients had normal values for both tests. Though not helpful in the diagnosis of hypothyroidism, the ten-minute uptake may provide useful information regarding the etiology and basic mechanism involved in this condi-

tion. Similarly, in non-toxic goiter, the ten-minute test seems to be of value in predicting the response to medical treatment.

The ease with which residual radioactivity in the neck is excluded when the ten-minute test is repeated makes it useful in studying changes in thyroid function from day to day. Its short duration makes it ideally suited for use with the new isotope of iodine,  $I^{131}$ , with its short half-life.

Two illustrative case reports are given.

**$I^{131}$  Labeled Triiodothyronine Erythrocyte Uptake of Mothers and Newborn Infants.** Norma R. Spafford, Edward A. Carr, Jr., George H. Lowrey, and William H. Beierwaltes. *Am. J. Dis. Child.* 100: 844-849, December 1960. (W. H. B., Department of Internal Medicine, University Hospital, Ann Arbor, Mich.)

It is usually necessary to diagnose congenital hypothyroidism promptly after birth if thyroid administration is to be started in time to produce reasonable intelligence. The *in vitro*  $I^{131}$  L-triiodothyronine red blood cell uptake test of Hamolsky *et al.* (*J. Clin. Endocrinol.* 17: 33, 1957; 19: 103, 1959. *Absts. in Radiology* 69: 790, 1957; 73: 829, 1959) has many applications in the study of thyroid function in the newborn period. It has an advantage over the serum protein-bound iodine concentration and butanol-extractable iodine concentration tests in not being influenced by previous administration of iodine-containing compounds to either the mother or infant, and unlike the  $I^{131}$  uptake test it does not subject the infant to radiation.

Eighty newborn infants and 8 mothers were studied by the *in vitro*  $I^{131}$  L-triiodothyronine red blood cell uptake test. Only those infants were studied whose parents had no personal or family history of thyroid disease. Only 1 specimen was obtained from each infant. Cord blood was employed in the study of 10 infants at delivery and femoral vein blood in the studies of the remaining 70 infants, who were one to seven days of age.

The mean uptake of the 8 mothers at delivery was 7.0 per cent. In the authors' laboratory the mean uptake of euthyroid nonpregnant women is 11.6 per cent. The mean uptake determined on the cord blood of the newborn infants was 9.9 per cent. The uptake among infants increased to a peak of 19.1 per cent on the second day of extrauterine life, fell to 11.6 per cent on the fifth day, and reached 14.3 per cent on the seventh day. Although the erythrocytic uptake at the time of birth is low, compared to normal adult values, it rises promptly thereafter to relatively high values and then returns to a range more comparable to the normal adult range.

**Solitary Hyperfunctioning Thyroid Nodules.** Glenn E. Sheline and Kenneth McCormack. *J. Clin. Endocrinol.* 20: 1401-1410, October 1960. (University of California School of Medicine, San Francisco 22, Calif.)

The thyroidal uptake and distribution of  $I^{131}$  were studied in 15 patients with clinically solitary nodules in the thyroid. In each patient the nodule was hyperfunctioning and accounted for almost all the activity; 9 of the patients were euthyroid, 5 were thyrotoxic, and 1 was in a borderline state between euthyroidism and thyrotoxicosis. Seven of the 15 patients were restudied after administration of triiodothyronine (25  $\mu$ g. three times daily for eight days); 2 others were studied after

administration of triiodothyronine or of TSH but not after both. Of the 5 patients given triiodothyronine, none displayed a significant change in total thyroidal  $I^{131}$  uptake or in the distribution of radioiodine. Similarly, in the patient with borderline thyrotoxicosis and 2 of the thyrotoxic patients, triiodothyronine failed to influence the uptake or distribution of  $I^{131}$ . Administration of TSH to 4 of the euthyroid patients led to an increase in the five-hour uptake; the twenty-four hour values were also elevated. Administration of TSH resulted in an increase in the five-hour uptake in 2 of the thyrotoxic patients; in the third thyrotoxic patient studied there was no increase. Scanning demonstrated that in each instance the non-nodular portion of the thyroid could account for the increase.

Thus, in the dosage employed, triiodothyronine did not appreciably influence the function of the hyperactive nodules, regardless of whether they produced excessive amounts of hormone. In this respect, these nodules behaved as does the thyroid tissue of Graves' disease. If it be assumed that lack of function in the non-nodular tissue indicates a lowered output of thyrotropic hormone by the pituitary, these nodules appear to represent abnormalities that are autonomous or are responsive to abnormally low levels of TSH. One is tempted to reason that the escape from pituitary control is similar in both toxic and nontoxic hyperfunctioning nodules and that the process may be the same in both, although observed in different phases of the disease sequence. Perhaps, in time, nontoxic nodules can give rise to thyrotoxicosis. With this possibility in mind, 5 of the patients with nontoxic hyperfunctioning nodules are being followed without definitive therapy.

Five figures; 2 tables. SYDNEY F. THOMAS, M.D.  
Palo Alto, Calif.

**The Measurement of Thyroidal Iodine Uptake Soon After Therapy with Radioiodine.** I. D. Thomas, T. H. Oddie, I. Hales, J. Myhill, and Elizabeth Fitzsimons. *J. Clin. Endocrinol.* 20: 1392-1400, October 1960. (Royal North Shore Hospital of Sydney, Crows Nest, N. S. W., Australia)

Serial tracer tests with radioiodine provide a useful, objective means of following the progress of a thyrotoxic patient who has been treated with  $I^{131}$ . Technical difficulties arise, however, when a small tracer dose is superimposed on the large residual amount of radioactivity in a thyroid gland in the first few weeks after  $I^{131}$  therapy. The authors describe an indirect way of measuring the thyroidal clearance rate under such circumstances.

Serial observations of residual radioactivity in the region of the thyroid gland and of urinary excretion of  $I^{131}$  were made during the early period after a therapeutic dose of radioiodine in 58 patients. Blocking the thyroid with potassium perchlorate increased the urinary excretion of  $I^{131}$  and increased the rate at which thyroidal radioactivity diminished. Assuming dynamic equilibrium between the several iodide compartments of the body, the thyroidal iodine uptake rate may be derived from such observations.

The rates of transfer and the relative amounts of iodine in the several compartments of the body are related by mathematical equations; these are developed in an Appendix, which is appended to the article.

Two figures; 3 tables. SYDNEY F. THOMAS, M.D.  
Palo Alto, Calif.

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**Labeling of Erythrocytes In Vitro with Radioiodine-Tagged L-Triiodothyronine as an Index of Thyroid Function: An Improved Hematocrit Correction.** Ralph Adams, Norman Specht, and Ivor Woodward. *J. Clin. Endocrinol.* 20: 1366-1372, October 1960. (College of Medical Evangelists, Los Angeles, Calif.)

The labeling of erythrocytes in plasma during incubation with  $I^{131}$ -tagged L-triiodothyronine ( $T_3$ ) was studied in blood samples prepared with a widely varying hematocrit. The percentage red-cell uptake corrected to a hematocrit of 100, as employed by other investigators for an index of thyroid function, was shown to vary considerably with changes in the hematocrit. This variation is sufficient to explain the difference reported by others in the average values for euthyroid males and females. Cell labeling was found to obey a simple equation derived from the law of mass action. The labeled  $T_3$  taken up by the red cells was proportional to the product of the red-cell mass and the concentration of labeled  $T_3$  remaining in the plasma after incubation. The constant of proportionality, or binding coefficient, was characteristic of a given plasma sample and was essentially independent of the hematocrit over a wide range. Therefore, it should be a more reliable index of thyroid function than the percentage of red-cell uptake per 100 hematocrit.

[The authors' technic shows an improvement over other methods of erythrocyte labeling which is worthwhile exploring, but they point out that for reproducible results, all details of labeling and washing should be standardized within a laboratory, and the fewest washings should be employed consistent with adequate removal of plasma.—S.F.T.]

Three figures; 2 tables. SYDNEY F. THOMAS, M.D.  
Palo Alto, Calif.

**Localization of Radioiodinated Antibodies in Rats Bearing Tumors Induced by N-2-Fluorenylacetylamine.** Eugene D. Day, Jakob A. Planinsek, and David Pressman. *J. Nat. Cancer Inst.* 25: 787-802, October 1960. (Roswell Park Memorial Institute, Buffalo, N. Y.)

The object in this series of experiments was to determine whether autochthonous rat tumors differed from transplanted rat tumors in their ability to fix antibodies *in vivo*.

When a radioiodinated antiserum globulin is injected intravenously into a rat, the distribution of the localizing antibodies contained in it is determined by the flow of blood to the organs and the efficiency with which they fix or trap the circulating antibody. This trapping efficiency is a function of the organs' content of accessible reacting antigens and the combining strength of the antigen-antibody combination. Rat kidney, for example, will localize antibodies directed against antigens accessible only in kidney and against antigens which are common to many organs. The former is called specific localizing antikidney antibody; the latter, cross-localizing antikidney antibody.

Tumors were induced in rats by N-2-fluorenylacetylamine (N-2-FAA), an agent well known for inducing a variety of tumors at a variety of sites. Antibodies were prepared in rabbits against liver tumors induced by N-2-FAA, labeled with  $I^{131}$ , and purified from additional portions of tumor. They were then mixed with  $I^{125}$ -labeled rabbit normal serum globulin as a paired label control and injected intravenously into rats bearing the induced liver tumors. Zones of localization

of antibody were determined eighteen hours later.

It was found that induced liver tumors localized antibodies which had been prepared in rabbits against like tumors. They also localized antibodies against normal liver, but did not, as a rule, localize antifibrin antibodies or fibrinogen during the eighteen hours between injection and assay. In general, they competed well with normal organs, such as liver, for circulating antibodies. In all these respects and by the ease with which they could be perfused, liver tumors induced by N-2-FAA sharply contrasted with transplanted tumors. In addition, radiolabeled antibodies which had localized in such induced tumors could be recovered from them by elution and returned to like tumors by the intravenous route.

One graph; 8 tables.

**Perfusion of the Isolated Prostatic Circulation with Radioactive Phosphorus ( $P^{32}$ ).** A. M. Behnam and John M. Ocker, Jr. *J. Urol.* 84: 753-757, December 1960. (University of Oregon Medical School, Portland, Ore.)

A study was undertaken by the authors to determine the ability of the prostate gland of the dog to pick up radioactive phosphorus injected into an extracorporeal circuit consisting of the prostatic circulation and a motor pump system. A search for the optimal form of radioactive phosphorus and an evaluation of factors which might influence its uptake by the prostate was included. Anatomic considerations are discussed, and the method of perfusion of the isolated prostatic circulation is described.

Fifty-two dogs were perfused, using different forms of radioactive phosphorus. In 24 dogs oxygenation was not employed, and a single head sismamotor pump was used, which was primed with 100 c.c. blood. In these animals 250 microcuries radiophosphorus was injected through the extracorporeal circuit. In the remainder oxygenation and a double head sismamotor pump were used, primed with 300 c.c. blood containing 750 microcuries radiophosphorus. Blood samples from the isolated circulation were drawn at certain intervals and from the peripheral circulation at corresponding intervals. At the end of the perfusion, the dog was sacrificed with an overdose of Nembutal. The liver, spleen, kidney, prostate, and bladder were removed for determination of tissue uptake of  $P^{32}$ . All the samples were counted for radioactivity with a G-M scaler.

Prostatic perfusion with  $P^{32}$  produces no side effects in the dog. Higher uptakes of  $P^{32}$  by the prostate than by other viscera can be obtained by this method. Oxygenation definitely increased the uptake of  $P^{32}$  by the dog's prostate. The inorganic forms of phosphorus yielded more satisfactory results than the organic forms, i.e., the uptake of  $P^{32}$  from organic phosphates was much less than that from inorganic phosphates.

Five figures; 1 table. JAMES T. T. CHEN, M.D.  
University of Pennsylvania

**Diagnostic Applications of Radiophosphorus for Malignant Neoplasms in Otorhinolaryngology.** Ken Nagatani. *Ann. Otol., Rhin. & Laryng.* 69: 1020-1029, December 1960. (School of Medicine, Kyoto University, Kyoto, Japan)

In a preliminary study the distribution of radioactive phosphorus in normal and neoplastic tissues was ob-



served by measuring their radioactivity by the calculation of differential absorption ratio and the radioautographic technic. The majority of the tissues bearing malignant tumors absorbed the  $P^{32}$  much more abundantly than the normal tissues of the same patient.

The author then administered a  $P^{32}$  solution intravenously to 78 patients of the Department of Otorhinolaryngology of Kyoto University Hospital (Japan) who had been prepared for radical cancer surgery. The average dose was 300 microcuries. Three miniature Geiger-Müller counter tubes were placed in contact with the skin surface directly over the tumor and in some instances inserted into a body cavity closely adjacent to the tumor.  $P^{32}$  activity in the skin on both the normal and the diseased side was measured and compared at one, three, and six hours following the injection of  $P^{32}$ . After analysis of the data in this series, it is concluded that a mean concentration ratio beyond 130 per cent signifies the existence of a malignant neoplasm. The author believes that this superficial counting technic might be used also during the course of and after a radical operation for malignant tumor of the ear, nose, or throat.

Four figures; 3 tables. JAMES W. BARBER, M.D.  
Cheyenne, Wyo.

**Recognition of Gastric Cancer by *in vivo* Radioautography.** Norman B. Ackerman, Donald B. Shahan, Arthur S. McFee, and Owen H. Wangenstein. *Ann. Surg.* 152: 602-611, October 1960. (University of Minnesota Hospitals, Minneapolis 14, Minn.)

A method for the early detection and diagnosis of gastric cancer has been developed which utilizes the selective uptake of radioactive phosphorus by neoplastic tissues. A balloon coated with a photosensitive emulsion is inverted and is attached to the open end of a rubber four-hole nasogastric tube. In a photographic darkroom the deflated balloon is passed nasally into the patient's stomach and then inflated with air until slight discomfort is experienced. The patient is returned to his bed and the balloon is kept inflated for four hours. Second air is given to allay any apprehension; Probanthine is administered intramuscularly immediately following intubation to promote a dry mouth by decreasing oral secretions. After an interval of four hours, the patient comes back to the darkroom for deflation and removal of the balloon. Injection of 150 c.c. of the developing solution into the balloon completes the *in vivo* radioautographic study. The appearance of a darkened area indicates that segment of the balloon which has been in contact with a cancer whose selective absorption of  $P^{32}$  is greater than that of the adjacent normal gastric tissue.

Balloon radioautographic studies have been performed on 58 patients. Positive tests were obtained in 7 symptomatic patients found at operation to have gastric carcinoma. Radioautography was falsely positive in 3 of 8 patients with symptomatic benign gastric ulcers. Investigation indicated that the false positives were obtained in healing ulcers and may be related to the presence of actively regenerating cells in an area of inflammation. Three patients who underwent balloon radioautography because of abnormal clinical or x-ray findings were found to have normal stomachs; operation disclosed deformity of the stomach by extrinsic pressure from a walled-off abscess due to a perforated gallbladder in 1 patient and from an enlarged liver containing metastatic cancer in another; in the third pa-

tient a carcinoma of the body of the pancreas was found at surgery. Balloon studies were negative in 40 asymptomatic gastric cancer "precursor patients"; this number included 5 with gastric polyps, 11 with pernicious anemia, 19 with long-standing achlorhydria, 2 with asymptomatic gastric ulcers, 2 with hypertrophic rugae, and 1 with a postoperative deformity of the stomach. In a subsequent series of 25 patients with benign gastric ulcers, only 1 false-positive was obtained.

The authors believe that this radioautographic technic may prove useful in the detection of asymptomatic mucosal gastric cancer.

Five figures; 2 tables. GEORGE A. SHIPMAN, M.D.  
Staten Island, N. Y.

**A Cooperative Assay of a Sample with Erythropoietic Stimulating Activity.** Geoffrey Keighley, Peter H. Lowy, Henry Borsook, Eugene Goldwasser, Albert S. Gordon, Theodore C. Prentice, Walter A. Rambach, Frederick Stohman, Jr., and Donald C. Van Dyke. *Blood* 16: 1424-1432, October 1960. (California Institute of Technology, Pasadena, Calif.)

Under the stimulus of severe anemia or hypoxia an erythropoietic-stimulating factor (ESF) appears in the plasma in sufficient concentration that injection of relatively small amounts of such plasma in normal animals results in stimulation of erythropoiesis. The lack of a common basis for comparing ESF from different sources, prepared in different ways and assayed by different methods, has been a deterrent to the solution of many unsolved problems. In an attempt to standardize the ESF factor, a batch of ESF was prepared at the California Institute of Technology and a sample was sent to each of seven laboratories to be assayed by whatever methods were being used by that laboratory. This paper presents a comparison of the results.

The standard material was assayed by ten different methods or major variations, eight using rats and two mice. Criteria of the erythropoietic effect were increase of hemoglobin in normal rats, increase in hematocrit in normal mice,  $Fe^{59}$  red cell incorporation in starved rats,  $Fe^{59}$  red cell incorporation in hypophysectomized and normal rats. By whatever method the material was assayed, a positive result was obtained and the responses in different laboratories using similar assays were comparable. It is proposed that a unit of ESF be defined tentatively as that amount of activity which will produce a net increase in incorporation into red cells of 20 per cent of injected  $Fe^{59}$  in a standardized starved rat assay. Based on a comparison of the results, one unit of the standard preparation CS-1 (the dry powder) would be equivalent to a total dose of approximately 1 mg.

Thirteen tables. SYDNEY F. THOMAS, M.D.  
Palo Alto, Calif.

**Venous Transport of  $Na^{22}$  from Healing Fractures in the Rabbit Tibia.** Lars Göthman. *Acta radiol.* 54: 469-482, December 1960. (Karolinska Institutet, Stockholm, Sweden)

The object of the investigation described here was to measure the disappearance of a radiosodium deposit in the bone marrow and thereby to study the variations in regional circulation in healing tibial fractures and to obtain a comparison between the transport of the activity through the vessels of the tibia marrow and those outside the tibia.

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injected slowly *via* a polyethylene catheter into the medullary cavity of undamaged and fractured tibias in 33 rabbits. Blood sampling was begun immediately after the conclusion of the injection. Samples were taken alternately from the femoral vein and from the nutrient vein for twenty-five minutes.

The investigation revealed that radioactivity deposited in the medullary cavity of the tibia was carried away through the femoral vein to a higher degree in three-to-four-week-old fractures than in undamaged bone. This suggests that there is increased vascularity in the soft parts outside the tibia during the phase of active callus formation. The disappearance-constant values for the nutrient vein, on the other hand, did not increase until later in the healing process, *i.e.*, in two-month-old fractures. This indicates that the increase in the regional circulation in the medullary cavity reaches its maximum later than that in the soft tissues outside the bone. When healing was complete (at four months), no significant difference was detected between the disappearance-constant values for the two routes or for the amount of activity removed as compared with normal bone.

Four figures; 6 tables. CLYDE M. WILLIAMS, M.D.  
University of Florida, Gainesville, Fla.

**Fat and Carbohydrate Metabolism in Humans. A Study of Nutritional and Hormonal Effects.** Josiah Brown. *California Med.* 93: 132-136, September 1960. (UCLA Medical Center, Los Angeles 24, Calif.)

As an index to the rate of fat utilization in man, the recovery of all radioactive carbon dioxide in the expired air was measured one hour following the intravenous injection of palmitate-1- $C^{14}$  in normal fasting subjects and in patients with chronic undernutrition and diabetes mellitus. The preliminary studies indicate that this technic for measuring the rate of fat utilization yields valid information.

It was found that glucose administration inhibits fat oxidation, confirming the results of similar studies. Thus it appears that the organism subsisting on a mixed diet will preferentially use carbohydrate, and that administration of carbohydrate inhibits both the mobilization of fatty acids from depots into the blood (thus lowering the amount of these acids in the blood) and the oxidation of fatty acids by the peripheral tissues. The inhibition of oxidation is more severe, so that even

with a smaller pool of fatty acids much less of the isotope is recovered. A schema is reproduced which shows movement of fatty acids from fat depots into circulating blood and into the liver.

Studies in patients with malnutrition and diabetes suggest that in states of chronic undernutrition or underutilization of carbohydrate the organism adapts by developing the ability to use fat at a more rapid rate.

Administration of growth hormones did not increase the rate of fatty acid oxidation as measured by the technic described.

One photograph; 7 charts.

SYDNEY F. THOMAS, M.D.  
Palo Alto, Calif.

**Distribution of Radioactivity After Intravenous Administration of 7,12-Dimethylbenz[a]anthracene-7,12- $C^{14}$  into the Mouse.** Herbert I. Hadler and Katharine Lee. *J. Nat. Cancer Inst.* 25: 697-701, October 1960. (Chicago Medical School, Chicago, Ill.)

In experiments on mice, within thirty seconds after the intravenous injection of  $C^{14}$ -labeled 7,12-dimethylbenz[a]anthracene, radioactivity was found in the skin, blood, liver, kidney, and spleen. The proportion of radioactivity carried by precipitated protein changed with time. These findings did not rule out a direct carcinogenic effect on mouse skin by 7,12-dimethylbenz[a]anthracene or its metabolites after the intravenous administration of the polynuclear hydrocarbon.

Three tables.

AUTHORS' SUMMARY

**Exchange of Radioactive Magnesium in Walker Carcinosarcoma 256: A Note.** Terence A. Rogers, Frances L. Haven, and Parker E. Mahan. *J. Nat. Cancer Inst.* 25: 887-888, October 1960. (University of Rochester School of Medicine and Dentistry, Rochester, N. Y.)

Rats with Walker carcinosarcoma 256 were injected with radioactive magnesium and then killed at intervals up to seven hours. The exchange of tumor intracellular magnesium with plasma magnesium was complete in four hours. This rapid exchange is comparable with that in the liver, myocardium, and kidney in normal rats, but unlike the slower exchange in the skeletal muscle, brain, erythrocytes, bone, and testes.

One chart.

AUTHORS' SUMMARY

## RADIATION EFFECTS—PROTECTION

**Radiological Hazards to Patients. Adrian Committee's Second Report.** *Brit. M. J.* 2: 1727-1728, Dec. 10, 1960.

The Adrian Committee, appointed by the Secretary of State for Scotland and the Minister of Health, has submitted its second report on the study of hazards to patients arising from the diagnostic and therapeutic use of ionizing radiation. General recommendations are similar to those promulgated by radiation protection teams in this country. After extensive study, compilation of data, and application of statistical methods, the following conclusions are reached:

"Our survey shows that all medical radiology in 1957-58, both diagnostic and therapeutic, resulted in a genetic dose of 19.3 mr per person per year. The main contributions to this total genetic dose are derived from diagnostic radiography (14.1 mr), radiotherapy of non-

malignant conditions (4.5 mr), and radiotherapy of malignant conditions (0.5 mr), whilst minor contributions are made by the medical uses of radioactive isotopes (0.18 mr), mass miniature radiography (0.01 mr), and dental radiography (0.01 mr)." The Committee feels that this level of exposure is somewhat less than that calculated in other countries with comparable radiological facilities. It is the opinion of the Committee that if the published recommendations for minimizing radiation exposures are carried out, the total annual genetic dose to the population from all forms of medical radiology can be reduced to a figure of 6 mr or less. Significantly, the Committee concludes "we do not believe that the levels [of radiation] indicated show any need for major restrictions in radiological practice and we are convinced that the number and type of the examinations or treatments must be dictated by the clinical

needs of the patient. In view, however, of the increasing use of ionizing radiations in the many activities of our present daily life and the greater opportunities for exposure of the population, it is necessary to reduce the gonad dose wherever possible. We are convinced that in many instances of diagnostic and therapeutic procedures this dose could be substantially reduced without any detriment to the efficiency of the examination or treatment."

It is felt that strong "consideration should always be given to alternative methods of treatment before radiotherapy of non-malignant conditions is undertaken."

JAMES W. BARBER, M.D.  
Cheyenne, Wyo.

**Radiation Hazards and Protection in Diagnostic Radiology.** R. C. Burr and A. F. Holloway. J. Canad. A. Radiologists 11: 75-80, December 1960. (Ontario Cancer Foundation, Kingston Clinic, Kingston, Ont., Canada)

This paper presents experimental data supporting some of the recommendations of the International Commission on Radiological Protection and also makes a brief report of a small survey of diagnostic x-ray machines across Canada, showing how the recommendations are being implemented.

The survey brought to light many deficiencies which could have been overlooked for long periods of time. An added filter was absent in 2 of the fluoroscopic machines examined, in spite of the fact that the radiologist had ordered the machine with a 3-mm. Al filter added. Seven of 39 x-ray machines had no filter and 9 out of 39 had less than the 2-mm. Al total filter recommended by the International Commission. Some of the timers were found to be in error. There was an error in calibration of the milliamperage meter in the fluoroscopic tube unit. Other faults that may come to light during examination of equipment include faulty diaphragms and faulty centering of the target. Defects in diaphragming are readily observed by the radiological staff and should be constantly checked. The staff may also examine filters in the overhead and the under-table tubes. Care on the part of the technician in the first place is one of the greatest weapons in the reduction of dose to the patient. It is a matter of simple arithmetic to see that, if a film is improperly taken and must be repeated, the patient's dose is multiplied by 2.

The report concludes with the following recommendations:

1. Adherence to the recommendations of the International Commission on Radiological Protection.
2. Adequate survey of equipment to discover defects in operation. This will require careful calibration of the measuring device.
3. Meticulous care by the diagnostic technician to avoid the necessity of repeat examinations.

Eleven figures.

**Radiation Hazards Associated with the Use of Mobile Image Intensifier X-Ray Machines.** B. D. P. Williamson. J. Coll. Radiologists Australasia 4: 117-124, December 1960. (Dominion X-Ray and Radium Laboratory, P.O. B. 1456, Christchurch, New Zealand)

Tests were made on two Muller BV-20 mobile image-intensifier x-ray machines to see whether any undue radiation hazards existed. The measurements were made at the maximum fluoroscopy settings of 75 kv and 3 ma.

At a distance of 32 cm. from the x-ray tube focus, the dose rate, measured in air with a Victoreen 5 r chamber, was 4.7 r per minute. The h.v.l. was 2.5 mm. Al. At a distance of 64 cm. from the focus, the x-ray dose rate was 1.0 r per minute. The maximum dose rate which a patient could receive with the use of the image intensifier was 12.0 r per minute at the tip of the shortest available cone. Careful use of the machine will obviate exposures to radiation intensities of this order, but it nevertheless must be realized that such exposures are possible.

The intensity of leakage radiation from the x-ray tube housing of each machine tested was measured with an ionization type of survey meter. At 50 cm. from the tube housing, at the maximum settings of 75 kv and 20 ma, and with the x-ray port sealed with lead of a thickness of about 4 mm., the maximum leakage intensities detected were 50 mr per hour for each machine. These were in directions at right angles to the length of the tube housings. Scattered radiation during fluoroscopy was measured with radiation test films. At lower settings than those used in the tests, the scattered radiation fields would be correspondingly less and the recommended average maximum operating times greater.

The results agree well with those obtained by earlier workers.

Suggestions for the safe use of the machine are made, and maximum average weekly operating times based on the recommendations of the International Commission on Radiological Protection and on the known exposures received by radiation workers in New Zealand are given in tabular form, as is a summary of radiation exposure of various significant organs and their influence on maximum operating times of the mobile image intensifier.

One graph; 2 tables.

S. ASMAR, M.D.  
Cleveland Metropolitan General Hospital

**Measurements of the Total Absorbed Irradiation in X-Ray Examinations of the Thorax and the Abdomen of Adults with a View to the Problem of Leukemia.** S. Goldman, W. Lorenz, and R. Wolf. Fortschr. a. d. Geb. d. Röntgenstrahlen 93: 269-281, September 1960. (In German) (Johannes-Gutenberg-Universität Mainz, Germany)

In discussing the injurious effects of ionizing radiation, three problems are of particular importance: damage to the gonads resulting in hereditary mutations, to the fetus causing malformation, and to the bone marrow, possibly producing leukemia. The authors' discussion is confined to the last two.

To evaluate the damage, the total absorbed volume dose of irradiation must be measured. This is done by means of a new counting device designed by Siemens-Reiniger-Werke. It consists of a large flat ionization chamber placed next to the diaphragm of the x-ray apparatus, so that the size as well as the quality of the beam is determined. When the beam is coned down, a smaller part of the chamber will be irradiated. The chamber is connected to a counting device which adds up the irradiation in rads per kilogram. The mean value was found to be 5 rads per kilogram in examinations of the thorax, 67 rads per kilogram in studies of the stomach, and 108 rads per kilogram in examinations of the colon. In 110 stomach examinations only about 20 per cent of the irradiation was produced by radiography, the rest resulting from fluoroscopy.

Extensive studies by Court-Brown and Doll (Leuke-

mia and Aplastic Anemia. London, Her Majesty's Stationery Office, 1957) showed that an irradiation of 7,500 rads per kilogram is needed to increase the leukemia incidence from 1 case in 20,000 persons to 1 in 10,000. On the basis of these calculations, routine chest or gastrointestinal examinations are negligible as a possible cause of leukemia, but the situation in the fetus is entirely different. Any fluoroscopic examination of the lower abdomen of the mother involves a total-body irradiation of the fetus. A dose of 10 rads per kilogram to the mother will double the probability of later development of leukemia in the unborn child. Therefore, the authors recommend that any woman in the child-bearing age be carefully questioned about an existing pregnancy before a gastrointestinal examination and that a colon study, which produces the greatest risk, be done preferably only during the first week after menstruation.

Great caution in infant irradiation is also recommended. Roentgen therapy to the thorax for thymus hyperplasia definitely increases the probability of leukemia. X-ray studies of small children should be done as rapidly as possible and with the x-ray beam coned down to the smallest possible field.

Eight figures; 2 tables.

WILLIAM A. MARSHALL, M.D.  
Chicago, Ill.

**Radiation Damage of Ribs and Clavicles in Breast-Cancer Patients.** Eberhard Baudisch. *Strahlentherapie* 113: 312-318, October 1960. (In German) (Universität Jena, Germany)

As early as 1927, spontaneous fractures of the femoral neck following radiation therapy for uterine cancer were reported. In 1941 radiation necrosis of ribs with spontaneous fractures in patients receiving x-ray therapy for breast cancer was reviewed by Eggs (*Strahlentherapie* 70: 315, 1941). The rib fractures usually occur in the region of the anterior axillary line. Fractures also occur in the clavicle. All these fractures have usually been encountered by chance when a routine x-ray examination was done on patients who had undergone radiation therapy.

The author describes in detail 4 patients with fractures of ribs and clavicles as shown on routine radiographs. A review of 369 patients who, during the years 1950 to 1955, received radiation therapy for breast cancer reveals that spontaneous fractures of ribs and clavicles due to radiation necrosis are rare occurrences; they should be differentiated from fractures of other etiology.

Four roentgenograms.

HERBERT POLLACK, M.D.  
Chicago, Ill.

**Desoxyribonucleoprotein Thromboembolism Following Total Body Irradiation: Case Report.** Zdenek Hruban, Mila I. Pierce, Sumati Nair, and Nancy E. Warner. *Blood* 16: 1629-1641, November 1960. (University of Chicago School of Medicine, Chicago, Ill.)

The purpose of this report is to record a fatal effect of radiation (desoxyribonucleoprotein thromboembolism) in a leukemic patient who died two hours after completion of the irradiation, before receiving planned transfusion of marrow from an identical twin.

The patient, an eleven-year-old girl, was given a calculated total dose of 800 rads at the midline with

radiation directed horizontally, half to each side. A 2-million-volt constant patented x-ray generator was used. The h.v.l. was 12.5 mm. Cu, the distance from the target to the midline was 277 cm., and the dose rate was 9.5 r per minute, measured in air. The time required was around three hours. During the administration of therapy, the patient became progressively more uncomfortable and restless, with a pulse of 150, a respiratory rate of 44 per minute, and brisk nasal bleeding. On return to her room, she died during whole-blood transfusion given preparatory to infusion of her twin's marrow. At autopsy the cause of death was found to be a sudden and nearly complete obstruction of the pulmonary circulation by desoxyribonucleic thromboemboli.

Clumping of DNA material is not a specific effect of radiation, but occurs wherever nuclear material is inadequately removed. It is seen in necrotizing portions of rapidly growing transplantable tumors, particularly in the Jensen tumor. In the authors' case it could be assumed to follow a massive destruction of a large volume of leukemic cells. The liberated nuclei, possibly increased by the pressure on the spleen and liver resulting from the patient's position during irradiation, clumped to form emboli. These adhered to the "sticky" capillary endothelium, coalesced, and plugged the lumina. The vascular defect produced by the leukemic process may have provided the alteration in the capillary endothelium necessary for the formation of thromboemboli, although irradiation damage of endothelium may have been a factor also. The dose rate of total-body irradiation of 9.5 rads per minute was higher than is recommended by some investigators and, although it was within the range used by others, was probably a factor in the massive cellular destruction demonstrated.

Whether or not the number of circulating leukemic cells changed during the course of irradiation in this patient is not known. A leukocyte count of 12,000 prior to treatment seems too low to account for the masses of fragmented cells seen within the vascular channels after death.

DNA thromboembolism is probably not as rare an event as the lack of reports would indicate, dyspnea appearing during irradiation of leukemic patients being its main clinical manifestation. Since the use of total-body irradiation may prove to be useful in the future management of leukemia, it would seem wise to select for this form of therapy patients with less extensive leukemic organ involvement and hyperleukocytosis, and to take care not to exert pressure on severely leukemic organs during the treatment.

Six photomicrographs; 1 table.

**Cataract as a Late Sequel of Contact Roentgen Therapy of Angiomas in Children.** V. Bek and K. Zahn. *Acta radiol.* 54: 443-448, December 1960. (Charles University, Prague, Czechoslovakia)

Contact roentgen therapy of radiosensitive angiomas in children yields excellent cosmetic and functional results and is generally believed to be safe for deeply situated tissues because of the rapid fall in the intensity of radiation with increasing depth of tissue. The high radiosensitivity of the young developing lens and adequacy of protective devices in this technic should be borne in mind, however, if good therapeutic results are not to be marred by late sequelae.

The authors performed control examinations of 51 children subjected to contact roentgen therapy for an-



gioma of or near the eyelids four to fourteen years previously. All had been treated with the van der Plaats apparatus; a nickel-plated lead hemispheric prosthesis 20 mm. in diameter and 2 mm. in thickness had covered the eye.

Typical radiation cataracts were found in 2 cases, ten and seven years after treatment. The authors are unable to assess accurately the dose delivered to the lens of these 2 patients, because of the difficulty in estimating even approximately how much radiation was absorbed in the prosthesis and how much penetrated to the epithelium of the lens. Skin doses to the angiomas were calculated as 1,500 r in one month to the first patient and, in the second case, 1,800 and 1,900 r, respectively, in 2 series with a five-month interval between. In neither patient was there any discernible post-irradiation skin change. The lower doses of irradiation received by the lens probably accumulated to produce a radiobiological effect. The authors' observations thus confirm statements that the effect of individual doses of radiation may be amassed in the lens.

Prognosis of radiation cataracts is uncertain. They usually remain stationary or progress slowly. Re-examination of these 2 cases one year later showed no change in the appearance or extent of the cataract.

It must be stressed that, in treating angioma in a child, one is dealing with a benign condition and no undue risks should be taken.

Two figures.

BYRON G. BROGDON, M.D.  
University of Florida, Gainesville, Fla.

**Elastosis and Cutaneous Irradiation Injuries.** L. J. A. Loewenthal and A. S. Pienaar. *South African M. J.* 34: 1076-1079, Dec. 17, 1960. (South African Institute for Medical Research, Johannesburg, Union of South Africa)

Elastosis is used in this paper to denote the histologic appearance of the connective tissue in what has been variously termed senile elastosis, solar elastosis, elastotic degeneration of collagen, basophil degeneration of collagen. It is present when the normal elastic fibers of the upper corium, extending to and including the pars papillaris, are replaced or overshadowed by a coarse mat of fibers three to five times thicker in diameter than normal. The fibers have no distinctive form or shape and often appear swollen, woolly, and amorphous, due to the irregular manner in which they react to the usual elastic-tissue stains.

Various workers have reported an increase in the number of elastic fibers in skin which has been damaged by x-rays, and others have assumed that elastosis can be produced in the same way and, in turn, plays a part in the development of cancer. Histologic examination of the skin from 5 x-irradiated patients of the authors, however, disproves this contention. The elastotic degeneration of skin can be correlated with prolonged exposure to sunlight but not with severe damage from irradiation.

Five photomicrographs.

**The Problem of Thorotrast Injuries.** Clinical and Radiological Studies on the Behavior of Thorium and Its Decay Products in the Organism. Part I. W. Börner, E. Moll, P. Schneider, and K. Stucke. *Fortschr. a. d. Geb. d. Röntgenstrahlen* 93: 287-297, September 1960. (In German) (Chirurgische Universitätsklinik Würzburg, Germany)

Thorotrast injuries can be divided into three groups:

localized granulomas; systemic damage to liver, spleen, lymphatic and circulatory systems, and blood-building organs; formation of cancer.

The danger of Thorotrast consists mainly in its fibrogenic activity. The accumulation of the injected medium in the various regions of the body varies greatly, as do the subjective findings. Some patients have subjective disturbances; others are asymptomatic and are unaware of the presence of Thorotrast in the body until its accidental discovery on roentgen films.

Thorotrast is predominantly a producer of alpha rays, the half-life of which is  $1.39 \times 10^{10}$  years. While the gamma rays are rather weak, they can be determined in the body by means of externally applied sensitive scintillation counters. These instruments will measure over deposits of Thorotrast an impulse rate amounting to two to five times the normal.

The authors carefully studied 8 patients in whom Thorotrast injections had been made eight to twenty-three years previously. Laboratory examinations resulted in findings that were mostly normal or of only borderline pathologic significance. The general appearance and condition of the patients was quite satisfactory. All were subjected to careful examination with the scintillation counter, especially in areas where the roentgenograms showed Thorotrast. Heavy deposits could usually be demonstrated over the liver and particularly over the spleen. Elsewhere high activity was commonly due to accumulation in lymph nodes.

The only possible way to diminish the irradiation seems to be through surgical removal of the deposits. Surgery is indicated if the Thorotrast granulomas cause considerable subjective symptoms; if at the hilus of the liver obstructive symptoms are produced, as jaundice due to obstruction of the common duct or portal hypertension and liver cirrhosis due to obstruction of the portal vein; if the surface measurements give a particularly high impulse rate over a readily resectable organ; if a suspicion of malignant change exists.

Two of the authors' patients came to surgery. At splenectomy in 1, a heavy package of involved lymph nodes was removed from the undersurface of the liver in the area of the hilus. In the other patient, gallstones were also present; at cholecystectomy numerous nodes were likewise removed from the hilus of the liver. Liver biopsies showed cirrhotic transformation by means of increased fibrous tissue containing deposits of Thorotrast.

Three roentgenograms; 3 photomicrographs; 2 tables.

WILLIAM A. MARSHALL, M.D.  
Chicago, Ill.

**Carcinoma of the Kidney Due to Thorotrast.** K. Krückemeyer, H. D. Lessmann, and K. R. Pudwitz. *Fortschr. a. d. Geb. d. Röntgenstrahlen* 93: 313-321, September 1960. (In German) (Städtische Krankenhaus Berlin-Neukölln, Germany)

A case is reported of carcinoma of the kidney at the site of injection, twenty-three years earlier, of Thorotrast.

Retrograde pyelography, with Thorotrast as the contrast agent, was performed in 1931 on a 19-year-old girl with left-sided renal colic. A medium-sized stone was found but surgery was not performed. The patient improved and was well for twenty years. In 1954 renal colic again developed. A flat plate of the urinary tract showed dense shadows, undoubtedly caused by Thorotrast deposits along the inner lining of the pelvis of both kidneys, giving almost the impression of an in-

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travenous pyelogram. A retrograde pyelogram with per-abrodil showed marked distortion and distention of the calyces on both sides, a good deal of destruction in the left side, and some delay in kidney function. Check-up examinations in 1957 and 1958 showed no change, but in 1959 the pyelonephritic symptoms had increased. The left kidney had shrunk and its function had markedly decreased. Examination of the kidney regions with a scintillation counter definitely showed radioactive emanation. The left kidney was removed.

Hydronephrosis and marked atrophy were apparent in the cortex. In the lower pole there was a 3-cm. tumor. A scintillation counter showed a radiation of h.v.l. of about 4 to 5 mm. Cu. Microscopically, the tumor consisted of carcinoma and of hyalinized connective tissue. Black particles of Thorotrast were scattered throughout the section, more densely in the connective tissue than in the cancer itself. The Thorotrast particles were either within large phagocytes or in between the cells. Contact autoradiographs of the histologic sections were made. In these, alpha and beta rays could be demonstrated. After a three-month exposure, a distinct blackening of the film was demonstrated, but only in the area that was in direct contact with Thorotrast accumulation in the specimen.

Thirteen figures, including 4 roentgenograms.

WILLIAM A. MARSHALL, M.D.  
Chicago, Ill.

**Thorotrast and Carcinogenesis. Report of a Case.** Richard B. Cattell and Fred Kuhn. *J.A.M.A.* 174: 413-415, Sept. 24, 1960. (Lahey Clinic, Boston, Mass.)

Although the majority of carcinomas that occur after administration of thorium dioxide suspension are found in the liver, local tumor induction has also been reported in man and animals. This is well illustrated by a case of widespread undifferentiated carcinoma of the peritoneum twenty-one years after salpingography, presumably with thorium dioxide as the contrast medium. Apparently at least one fallopian tube was patent at that time, and considerable quantities of the medium spilled into the peritoneal cavity.

In April 1959 the patient came to the Lahey Clinic because of several attacks of low abdominal pain during the preceding five months. A gastrointestinal series showed irregularities of the distal jejunum and ileum suggesting extrinsic pressure, and the radiological diagnosis was diffuse inflammatory change secondary to the contrast medium. At laparotomy the operative findings were generalized peritoneal granulomatosis and almost complete obliteration of the uterus and its appendages. Supracervical hysterectomy with bilateral salpingo-oophorectomy was performed, and biopsy specimens of the greater omentum and pelvic peritoneum were obtained. No evidence of neoplastic disease was found. Eight months later, the abdomen was re-explored and two large masses involving the walls of the rectum and sigmoid colon were found, together with numerous nodules over the anterior surfaces of both lobes of the liver. The sigmoid and several loops of small intestine were fixed in the pelvis by fibrogranulomatous tissue. Tumor biopsy was the only procedure carried out, and the final pathological report indicated undifferentiated carcinoma. The patient died on the eighth postoperative day.

Two roentgenograms; 2 photomicrographs.

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**Neoplasms Among A-Bomb Survivors in Hiroshima: First Report of the Research Committee on Tumor Statistics, Hiroshima City Medical Association, Hiroshima, Japan.** Tomin Harada and Morihiro Ishida. *J. Nat. Cancer Inst.* 25: 1253-1264, December 1960. (Hiroshima, Japan)

This paper presents an analysis of the incidence of malignant neoplasms diagnosed from May 1957 to December 1958 in survivors of the 1945 atomic bombing of Hiroshima. To study the relation between malignant neoplasms and radiation doses, the Hiroshima City Medical Association established a community Tumor Registry. All tumor cases, both malignant and benign, diagnosed in hospitals or clinics within the city limits were reported and the history of exposure was obtained from records which reflect extensive field investigation of survivors over many years. The data, therefore, provide basic information on the exposed and the unexposed segments of the population of Hiroshima.

Approximately 1,750 cases of malignant and 810 of benign tumors were registered in the twenty-month period. The incidence among the survivors of the A-bomb varies directly with radiation dose, in so far as it may be inferred from distance from the hypocenter at exposure. The incidence of all malignant neoplasms among the survivors who were within 1,000 meters is more than four times that of the nonexposed population, and the incidence of benign tumors in those exposed within 1,500 meters is also significantly higher than among the nonexposed. For survivors who were under 1,500 meters from the hypocenter, there are significant differences between the number of observed cancers of the lung, stomach, uterus, and ovary and the expected number of cases as calculated from the age-specific rates of the nonexposed population. The increased incidence among survivors within 1,500 meters is not related to sex or age.

The impression from this analysis is that the incidence of all malignant neoplasms increases as a function of dose, exponential or linear. A true carcinogenic effect has been postulated, but an alternative explanation is that radiation simply accelerates the appearance of neoplasms without increasing their lifetime incidence. The data seem to support the hypothesis that the increase is absolute, not a mere shift in age-specific incidence. The evidence suggests that specific organs or tissues differ in their radiosensitivity or that specific sites differ as to time lag from exposure to tumor development. Further analysis is necessary to establish definite conclusions on these matters.

Two figures; 8 tables.

**Fallout Dosage and Monitoring.** Simon Kinsman. *California Med.* 93: 72-78, August 1960. (Department of Health, Education and Welfare, U.S.P.H.S., Room 447, Federal Office Bldg., San Francisco 2, Calif.)

This article gives practical information on fall-out and monitoring, essential to a radiologist at the scene of a megaton detonation, and should be read in its entirety as it does not lend itself to abstracting.

Graphs give (1) a comparison in size of A- and H-bomb mushrooms and an ordinary thunderstorm cloud and (2) factors affecting the distribution of radioactive particles.

Estimates of probable contamination from a 15-megaton weapon one, three, and six hours after the explosion are tabulated, as are supportable risks of beta-gamma activity in the water supply and estimations of

the probable decrease of the radiation hazard with time, following the rule that for every sevenfold increase in age of the fission products there will be a tenfold reduction in radioactivity or intensity of radiation.

With a wide variety of contaminants present in different amounts, each decaying at its own rate, the task of obtaining the desired information on the amount of radiation which a person might receive if he were required to work in the fall-out area appears difficult. There is, however, an empirical relation between the intensity of radiation in the fall-out, the time interval between radiation measurements, and the average decay constant for fission products. This is exponential or logarithmic, and all expressions of time must be in terms of the same unit, generally in hours. The relationship between the total-body cumulative dose, the intensity of radiation an hour after the explosion, and the length of time of exposure also involves a logarithmic solution. Both of these empirical relationships are incorporated in a nomograph, with a detailed explanation.

Monitoring is generally divided into two steps. The first, concerned with gross contamination, is a rapid survey to determine the immediate safety precautions and necessary rescue operations. The second should be a detailed and accurate survey over a considerable time to obtain information on the exact nature, extent, and rate of decay of radioactivity present.

Salvage of food and water is always a problem. Food and utensils that were in closed drawers or tight cupboards will be safe. Even if tap water continues running, it should not be used before official confirmation as to its safety in regard both to such dangers as typhoid and to radioactivity. Most of the radioactive materials will be removed by household water-softeners or by trickling through several feet of sand and dirt before going to the purification plant.

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**A Modified Method for Personnel Monitoring. I. Hemispherical Filters. II. Automatic Dose Estimation.** P. G. Lale. *Brit. J. Radiol.* **33**: 748-756, December 1960. (Guy's Hospital, London, S.E. 1, England)

X-ray film sensitivity varies widely with the energy of the incident radiation, and this has led to the common use of filters with films for personnel monitoring. The filters which have been employed have always been flat in shape, causing filtration to alter with the angle of incidence. Since the variation of the latter can be considerable in practice, errors in response and in energy estimation will occur. In the author's opinion, such errors can largely be eliminated by the use of a hemispherical tin shell, filled with plastic to insure electron equilibrium. Radiation falling near the center of the filtered area has substantially constant filtration independent of the angle of incidence. The filter is surrounded by lead of 0.5 mm. thickness to prevent low-energy rays being scattered in this region. The "unfiltered" part of the film has 1 mm. of plastic on either side to remove high-speed electrons scattered from nearby objects. By combining a proportion of one density to the other, it is possible to obtain either a flat response or one following the backscatter factor for large fields over the range 30 kev to 1.5 Mev in effective energy.

In the second part of the paper the author describes an instrument (including circuit diagrams) for rapid

measurement of the films, giving a direct reading of the exposure dose. The contribution of soft or hard radiation can be obtained separately by depressing a switch.

Six figures; 3 tables.  
LUCILLE DU SAULT  
The Henry Ford Hospital

**Measurements of the Bone-Marrow Dose in Therapeutic and Diagnostic Roentgen Exposures of Infants.** L. Papagnani and B. Roseo. *Fortschr. a. d. Geb. d. Röntgenstrahlen* **93**: 281-286, September 1960. (In German) (Ospedale Maggiore, Milan, Italy)

The sensitivity to ionizing irradiation is particularly high in infants. Recently various reports have appeared in the literature, showing that leukemia may be caused by x-irradiation in infancy. Because active bone marrow is present all over the infant's body, roentgen examination of any part produces an exposure of blood-building cells. In addition, for technical reasons a much larger part of the body is irradiated in infants than in adults.

The cadaver of a one-month-old baby was used in a study of bone-marrow exposure in the usual x-ray examinations and in irradiation of the thymus. Small ionization chambers were placed in the sternum, the sixth dorsal vertebra, the fifth lumbar vertebra, the posterior part of the skull, and the shoulder, elbow, wrist, hip, knee, and ankle. Careful measurements were taken in each area during x-irradiation of the thymus and the following routine examinations: fluoroscopy of the thorax and of the abdomen, chest roentgenography, and pelviroadiography. The results were carefully tabulated both for unfiltered rays and for rays filtered through 2 mm. of aluminum.

On the basis of these measurements the following recommendations are made: X-ray therapy of the hyperplastic thymus should be carried out with rather low voltage (120 kv, 5 mm. aluminum filter) because the thymus is located quite superficially below the sternum. Fluoroscopic examinations of the chest and abdomen should be done with a 2-mm. aluminum filter. In radiography of the chest and abdomen the x-ray beam should be strictly confined to the field desired and again a 2-mm. aluminum filter should be employed.

Five tables.  
WILLIAM A. MARSHALL, M.D.  
Chicago, Ill.

**Effects of Protracted Irradiation on the Blood-Forming Organs of the Rat. Part II: Divided Doses.** A. H. Pontifex and L. F. Lamerton. *Brit. J. Radiol.* **33**: 736-747, December 1960. (Royal Cancer Hospital, Fulham Rd., London, S. W. 3, England)

In Part I of this article, Lamerton *et al.* (*Brit. J. Radiol.* **33**: 287, 1960. *Abst. in Radiology* **76**: 528, 1961) discussed the response of the blood-forming organs of the rat to continuous irradiation from a  $Cs^{137}$  source. The present installment is concerned with the response of the blood and bone marrow of rats to daily x-irradiation with doses ranging from 15 to 200 rads/day at a rate of 30 rads/min. The results are compared with those previously obtained. The mean accumulated dose before death was plotted against daily dose. The values of accumulated dose (and survival times) obtained in the present experiments with interrupted exposure were less than those for continuous exposure. After correcting for quality, the interrupted irradiation was found to be more efficient than continuous irradiation in causing death, by a factor of 1.5 to 1.8.

In both experiments a steady state in the peripheral blood count was maintained for long periods of time at the lower dose-rates, but under divided doses of radiation the steady state is represented by a subnormal level of peripheral blood count. Also the total radiation doses that can be accumulated before death at the various dose rates are somewhat lower with divided than with continuous irradiation.

Three splenectomized rats showed a greater weight gain and a more rapid fall in the mononuclear count, without evidence of even slight recovery, than intact animals. They survived about thirty days longer, probably due to the reduced platelet fall.

A study of the femoral bone marrow revealed a fall in the mitotic index, a recovery to higher than normal by about thirty days, and then a slow decline until death at approximately sixty days. It is presumably the increase of mitotic activity in a depleted marrow which accounts for the fairly stable peripheral blood picture. Some discussion of possible mechanisms involved in the maintenance of a steady state is given.

Eleven figures; 1 table.

LUCILLE DU SAULT  
The Henry Ford Hospital

**The Effect of Homologous Marrow Transplantation on the Survival of Monkeys Following Sublethal Whole-Body Radiation.** Frances E. Newsome and R. R. Overman. *Blood* 16: 1762-1769, December 1960. (University of Tennessee College of Medicine, Memphis, Tenn.)

A lethal or supralethal dose of roentgen irradiation delays the primary antibody response in animals for a period long enough to permit the initial acceptance of foreign hematopoietic cells. If a sublethal dose of radiation is given, however, the animal rejects the donor cells much earlier. This rejection has been described by Congdon *et al.* (*J. Nat. Cancer Inst.* 18: 603, 1957. *Abst. in Radiology* 70: 633, 1958) as a "violent immune response" accompanied by bone-marrow failure. Because of the possibility of the recovery of the marrow from these low doses of radiation without the injection of foreign cells, it seemed reasonable to suppose that the timing of the "violent reaction" in respect to the process of recovery may influence the ultimate survival of the animals. It was therefore decided to investigate this relationship in the *Rhesus* monkey by giving homologous bone marrow thirty and forty-eight hours after a sublethal dose of 550 r x-irradiation.

Three series of monkeys were irradiated: One group of 5 received no bone marrow; a second group of 7 received bone marrow thirty hours post-irradiation; the third group received bone marrow forty-eight hours after irradiation. None of the control animals died. Of the 7 receiving bone marrow thirty hours after irradiation, 6 died between ten and fifteen days with gross symptoms resembling those produced by a lethal dose of irradiation. The effects of marrow given forty-eight hours after irradiation differed little from those produced by irradiation alone.

This comparison of the results of marrow injection thirty and forty-eight hours after irradiation suggests that in the thirty-hour group the injection elicited a more violent reaction or occurred at a critical time during recovery from the irradiation. As the marrow apparently had little effect when given after forty-eight hours, it might be supposed that the process of recovery was well under way at the time of the reaction. It is

also possible that the host's immune response had recovered sufficiently to react against the foreign cells before they became as well established as did the marrow cells given thirty hours after irradiation.

One photograph; 3 graphs; 1 table.

**Immunologic Response to Lymphocytic Choriomeningitis Virus in Lethally Irradiated Mice Treated with Bone Marrow.** Delta E. Uphoff and Victor H. Haas. *J. Nat. Cancer Inst.* 25: 779-786, October 1960. (National Institutes of Health, Bethesda, Md.)

Lymphocytic choriomeningitis-immune, non-immune, and lymphocytic choriomeningitis-carrier mice were exposed to lethal total-body x-irradiation and protected by an inoculation of marrow from either immune or non-immune donors. Subsequent challenge of the surviving chimeras with potent homologous virus established that, under the conditions of these experiments, immunity was a function of the host and not of the transplanted tissue. It further appeared that irradiation occasionally caused a significant weakening of the pre-existing immunity as demonstrated by the observation that 3 of 22 immunized mice succumbed to challenge after exposure to lethal irradiation and protection with marrow from immunized mice. In the majority of mice a previously established immunity remained unimpaired and in no instance did marrow from an immune donor confer immunity on a previously non-immune host, even when combined with inoculation of splenic tissue from an immune donor.

The following hypothesis is proposed as a possible way to reconcile the divergent concepts of host-graft interaction (see, for instance, Hollingsworth. *Blood* 14: 548, 1959. Uphoff. *J. Nat. Cancer Inst.* 19: 123, 1957. *Abst. in Radiology* 70: 797, 1958).

1. An antigen introduced before irradiation establishes within the host a pattern of immunologic response which is usually, though not invariably, radiation-resistant.

2. The irradiation may fix the immune mechanisms of the host to the conditions existing at the time of exposure. After irradiation, the host tissue responds with immunologic competence only to those antigens with which it had pre-irradiation experience.

3. The host does not respond immunologically to new antigenic stimuli or to stimuli to which it would not normally respond. It would not react immunologically to a marrow homograft unless it had been pre-immunized to donor-strain antigenic material. Irradiation would usually not destroy the pre-existing ability to respond immunologically to the marrow graft.

4. Under conditions in which immunologic competence of the marrow graft exists, the graft may react against the foreign antigens of the irradiated host producing "secondary disease."

5. Such marrow may also impose on the host its own immunologic mechanism, as in the transfer of antibody production capabilities of the rabbit to the treated rat, in the development of the heterologous chimeras.

**Effects of Alkylating Drugs and Combinations of X-Irradiation and Cortisone on Tumor Immunity.** Frederick W. Preston, Elizabeth Jane Jackson, George C. Henegar, and Robert Schrek. *Ann. Surg.* 152: 594-600, October 1960. (VA Research Hospital, Chicago, Ill.)

The fact that some cancer patients deteriorate rapidly

when given an alkylating drug, as triethylenethiophosphoramide (TSPA), suggests that the defense mechanism holding the tumor in check is impaired by the drug. To test this theory, the authors undertook some studies on rats with Bagg lymphosarcoma. This tumor is fatal to about 83 per cent of inoculated animals. In the remaining 17 per cent, after an initial period of growth, it spontaneously and completely regresses. Rats in whom regression has occurred are subsequently immune to further inoculation with Bagg tumor.

Some immune animals were given the alkylating

agents, TSPA and nitrogen mustard, intraperitoneally, and Bagg tumor was again implanted. The tumor failed to grow and the immunity of the animals was considered to have been unimpaired. Another group of animals were subjected to about 150 to 200 r whole body x-irradiation and cortisone. Inoculation with Bagg tumor in the irradiated animals was followed by tumor formation in 22 per cent of cases, indicating some loss of tumor immunity.

Six tables.

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